Journal of International Economic
Integration 2(1), Spring 1987, 112-128.

Dynamic Incentive Structures and Industrial Policy

Gerald Nickelsburg*

In this paper a model is proposed in which intrinsic aspects of labor markets provide differential indentives for production. Industrial policy of the type followed by MITI is then analysed as a means of achieving optimal allocations. It is found that such strategies, though justified as a way to achieve competitive equilibrium, are not optimal for the country imposing them and that a two country game arises naturally.

I. Introduction

In the past few years the changing world patterns of trade have breathed new life into protectionist causes and sparked a controversy among economists and policy makers over the efficacy and desirability of industrial policy planning by the government. There are seleral camps on the issue of industrial policy, those who claim that at best it has been innocuous and at worst it has resulted in a lowering of national income through subsidization of inefficient industry (Saxonhouse (1984), Summers (1983)), those who claim that such a policy might not be needed in a world in which all firms operated without subsidy but that since some do operate with subsidies it is necessary to follow the same course, (Goldstein and Krasner (1984), Thurow (1980), Vogel (1980), Pascale and Athos (1981), Jacquemin (1979)), and finally there is a group of economists who view the controversy pragmatically by claiming that some form of industrial policy will be implemented because it is particularly popular and there should therefore be investigations into damage control. (Krugman (1983) presents a survey of this literature.)

Much of the literature up to this point admits a role for industrial policy whenever conditions of classic market failure such as increasing returns, externalities, barriers

*Assistant Professor of Economics, University of Southern California, U.S.A.

The author wishes to thank Victor Canto, Gart Saxonhouse, Dan Spulber and Takahiro Miyao and the participants at a workshop on industrial policy at USC for their valuable comments. All errors are exclusively the author's.

to competition or different private and public investment rates of return exist. (See for example Urban (1983), Brander and Spencer (1982) and Eliasson (1983)). Thus, there has been increasing focus on identifying where and if market imperfections occur. This paper takes a differnet approach to industrial policy analysis. Specifically we find that when dynamic reward patterns differ between countries, simply becasuse these countries themselves do not possess identical cultures, then the free market equilibrium is generally not optimal and therefore there exists an opportunity for corrective industrial policy.

Many have claimed that much of the Japanese success with industrial policy was due to their heavy subsidization of research and development activity (Pascale and Athos (1981), Hosomi and Okumura (1982), Johnson (1982), Vogel (1979)). Since diffusion of knowledge is a fact of life for R & D, there is an obvious failure of the conditions for optimum allocations, namely the existence of different private and social returns to research. Thus, much of the analytical work on industrial policy has focused on product innovation (Adams, Cherkes and Wescott (1983), Jaquemin (1979), Pinder (1982).) Our theory is linked to this literature by being set in the context of product innovation production. However, enen if private rates of return are euqal to public rates of return because of the absense of diffusion, out theory still retains a role for industrial policy. Indeed our theory implies that whenever there are extra−firm incentives which alter the responsiveness of individuals to marginal incentives by the firm, international equilibrium will generally be non−optimal.

We begin by assuming that one factor market, in our example labor markets, is not integrated between countries, and even though current market structures might be identical and neoclassical ; the dynamic rates of return to the two factors will possibly be different. This can arise in many ways however the most common would be found where tradition or culture dictates different relations between employer and employee. We then find that in fact an organization for industrial planning such as MITI in Japan can in fact improve the domestic and world allocation of goods. Secondly we find that such an organization may have an incentive to use market power to increase domestic welfare at the expense of the foreign country and when this occurs the foreign country can indeed improve welfare by responding in kind. Third, as in the classical bilateral monopoly problem, there may in certain circumstances be room for welfare optimizing bilateral trade agreements.

These results seem to suggest that perhaps the usual dismissal of cries of "unfair competition" may be too hasty, at least in some cases, and that some empirical investigation into the nature of the domestic industry subsidies of by various countries

in the context of their cultural proclivities toward labor markets and industrial structure is needed on a case by case basis before it is concluded that because free trade is optimal in a fully neoclassical static world, any intervention by governments is necessarily bad. This paper proceeds as follows, the remainder of the present section revicws the basic ideas we are presenting with respect to differences in dynamic rewards to labor and some of the motivation of a MITI like agency. The following section presents some formal modelling preliminaries which make our basic suboptimality point. Section three presents a discussion and some results on the use of industrial policy to achieve optimality. section four concludes the presentation with a demonstration of counter policies which will imporve welfare over the passive free trade strategy.

The most fundamental idea we are presenting in this paper is that even though the labor markets are identical in seemingly all aspects, for example all labor is wage labor, there are many buyers and sellers in every skill category, wages are set by an auctioneer to clear markets and all products are freely sold internationally, the labor markets may in fact be quite different. For our exposition we will rely heavily on Japanese-United States labor market comparisons however these ideas are more general than our illustrative case. (For a description of the Japanese experience see for example Vogel (1979).) In each labor market there are several aspects to a job. Many aspects such as working conditions, wages, termination probabilities and so forth have been analyzed extensively in the labor economics literature and we will not examine them here. One aspect not well examined is the fact that future employment changes and employment possibilities will effect current productivity and job performance. That is, if a future job or future wage is dependent upon successful completion of certain projects in the present job, then the employee has an extra-firm incentive to bring these projects to fruition.

While these incestives do not cost the firm, the firm reaps the benefits of such incentives. Moreover, these incentives are difficult to capture in a current market setting because there does not exist a separate market for them. But, what is more important for our analysis is the fact that on average they differ from culture to culture. To be sure these differences could be captured in price of labor differnetials as would be predicted by neoclassical analysis. That is, high external incentive countries pay higher wages since the marginal product of labor is higher. However if the incentives translate into productivity in anything other than a linear way, without a market in Marxian standard units of labor there would be a differnetial allocation of inputs across countries, an allocation which would be a source of resource

inefficiency. This inefficiency gives rise to a role for industrial policy in economic planning.

For example, traditionally in the United States employees retain tenuous loyalties to their employers. Mobility, particularly among the most creative and productive employees tends to be quite high, and it is common for companies to "raid" other firms for top employees. During the course of a lifetime one worker may have several or many employers. Since new employers base salary offerings on prospects for success and expected productivity, it is to the advantage of the employee to advertise his successes. For example, a person involved in new product design who through a program of research and development had developed new cost saving technology would be sure to make it known generally that he was in fact responsible for this development. By convincing others of his capatilities in new product development, the employer can then increase his salary over and above whatever bonus was paid for the invention either by changing firms or by inducing an employee raid prevention raise from the current employer. Consequently there are many incentives to produce exceptionally well and advertise that production.

From the firms point of view, this state of affairs is a mixed blessing. First, the firm receives an employee who has incentives in excess of his current pay to produce new product technology. With patent rights the firm may protect that technology, however since alternative similar technologies can be easily produced once the knowledge of the first innovation is dispersed, the firm will loose some of the advantage of this technology through advertisement by the worker of it. We take these as stylized facts about our model U.S. labor markets which are directly related to the dynamic nature of the market.

In our idealized Japanese labor market owrkers by tradition change jobs infrequently if at all. (see Vogel, Johnson, and Saxonhouse.) If a worker is to work for one firm for his entire life, because by tradition and taste this is the acceptable way to behave, then the worker will develop strong loyalties to his employer. In the case of the new product design worker, there is an adsence of incentive to publicize the new technology he develops. Obviously this is because such advertisement will increase the dispersion of the technology, reduce his companies profits and therefore indirectly hurt him. Therefore, whatever is developed will remain with the firm longer than in the U. S. case. However, the worker with guaranteed lifetime employment is also lacking incentives external to the cost the firm is willing to pay to produce because the reputation effects will have no bearing on his future market value. Thus our Japanese company has greater benefit per innovation due to the increased incentive for privacy

and less external incentives for the production of innovations due to the differing dynamic labor demand than the U.S. firms.

It will follow then that, except in the rare case that these incentives cancel each other out, the wages paid to workers in the two countries relative to the price paid for other factor inputs will be different. This will be true even if workers are able to identify the differences because part of the cost of innovation in the U.S. will be borne by future employers who use the past performance of workers as a screening device. Without a perfect market for human capital, there will not exist an international pricing mechanism which will equate the relative prices of resources to innovation labor across countries. In fact, the only free market mechanism available would be the removal of all barriers to labor across countries and the complete integration of the two economies.

II. Some Theoretical Foundations

In this section we set out our basic formal model and derive the sub−optimality result which leads us to think of industrial policy as a possible viable alternative. Necessarily we model our ideas in a simple wqy. For example, we do not employ the standard $2 \times 2 \times 2$ international trade model because of the well known difficulties of introducing dynamic factors and because of the lack of robustness of some key relults. However, our simplifications could be weakened immensely without altering our results. We do not do that here because in a much more general model the sources of inefficiency and reallocation of resources engendered by policy are much less transparent. However, as we proceed we will make reference to many of the inessential simplifications.

Since our focus is on technological innovation and the differential pricing of labor inputs in its production we suppose that there exists a good I which is the product of an innovation. After one period of use I has a rate of decay, or rate of discount r. All innovations are assumed to produce I, one unit for each innovation. Thus we are abstracting from the uncertainty associated with innovation proudction and the lumpiness of product innovation. With decay or discount rate r, the varles of any innovation is I/r, in units of I. If we assume that technology is diffused at a rate $(1 - v)$ beginning in the first period after the introduction of I, then the return to the firm in terms of good I is :

$$f = I \cdot (1 + r)/(1 + r - v) \tag{1}$$

What equation (1) illustrates is that public and private returns to innovation differ. Whenever this occurs there is obviously room for improvement. Namely since private returns to investment are less than public returns clearly there is a case of underinvestment and a reason to subsidize investment. However, since worldwide diffusion of technology is assumed to exist, the privatization of all domestic returns to technology through subsidy would still result in an equation identical to equation (1) and different from I/r. Therefore without loss of generality we take (1) to hold and ignore any discrepency between public domestic return to innovation production and private domestic return.

Our two countries will be indicated by the subscripts J and U. For analytic simplicity we will assume Cobb−Douglas technologies. Assuming our representative firm for each country and identical production functions for innovations for each country we have the production relation :

$$I_i = e_i^{\alpha} R_i^{\beta} \quad i = J,\ U. \tag{2}$$

In equation (2) α and β are constants which are independent of country, R is a resource input and e is a labor innovative effort input. The resource input can be purchased on world markets at a relative price π, where π is the price of R in units of I. We assume that I has a numeraire price of 1.

Labor is assumed to be completely immobile across countries and is assumed to provide e. Firms hire L workers and from each receives a minimum effort $\bar{e}$. To aquire additional e from workers requires the provision of additional incentives. Since e is unobservable we assume that in addition to paying the wage, W, firms pay a bonus to workers who produce I in the amount PI. Stated formally our firm operating in a completely competitive market wishes to maximize profit by solving :

$$\begin{aligned} &\max : \frac{I(1+r)}{1+r-v} - \pi R - PI - \omega L \\ &\text{subject to} : I = e^{\alpha} R^{\beta} \\ &\qquad\qquad e = L \cdot \bar{e} + \tilde{e}, \end{aligned} \tag{3}$$

where $\tilde{e}$ is the variable part of e, responsive to the additional incentives once the worker is hired. It is assumed that these incentives appear as bonuses for output because the input e is not easily measured except as it appears in output. Thus the firm must select a bonus price P, and inout level R and an employment level L. We assume further that the firm knows the employees reaction function and thus can determine P

by optimizing with respect to $\tilde{e}(P)$.

Employees are assumed to supply labor inelastically at whatever wage ω clears the market for $\bar{L}$ supply. However Workers have disutility of effort. Workers effort–income utility choice is assumed to be the values which maximize the utility function :

$$U_i = P_i I_i - \frac{1}{2} a_i e_i^2 \qquad i = J,\ U, \tag{4}$$

where a_i is a taste parameter which can be smaller due to the existence of future rewards to present production performance and which also might capture certain cultural or taste proclivities for the provision of job effort.

Substituting the production function (2) into equation (4), assuming workers have no control over the level of R or the bonus price P, and choosing the maximum utility level of e we find the worker reaction function :

$$\tilde{e}_i = \left[\frac{P_i R_i^{\beta} \alpha}{a_i} \right]^{\frac{1}{2-\alpha}} - \bar{e}_i \qquad i = J, U. \tag{5}$$

From equation (5) $\bar{e}$ is a source of lumpiness in a firm's decision rule. That is, the firm must decide first whether or not to pruchase the services of a worker and receive the nondivisible sum $\bar{e}$ and then, conditional on having hired the worker, what the level of incentive pay will be. This indivisibility will strengthen our arguments, but since it also unnecessarily complicates the algebra we will take $\bar{e} = 0$. With $\bar{e} = 0$ all of the wage is reflected in the incentive pay P, and we can without loss of generality take the number of workers $\bar{L} = 1$.

Thus the firm's problem comes down to a choice of the variable inputs e and R which it uses to produce I. The firm's optimal choice from a maximization of profit (4) subject to worker reaction function (5) is found to be :

$$\hat{P}_i = \left[\frac{\alpha}{2} \right] \frac{1+r}{1+r-v_i} \tag{6}$$

$$\hat{R}_i = C \left[\frac{1+r}{1+r-v_i} \right]^{\frac{2}{2-\alpha-2\beta}} \left[\pi \right]^{\frac{2-\alpha}{2-\alpha-2\beta}} \left[\frac{1}{a_i} \right]^{\frac{\alpha}{2-\alpha-2\beta}} \qquad i = J, U. \tag{7}$$

The variable C in equation (7) is a constant which depends on α and β. The fact that a_i does not appear in euqation (6) is because we choose a particularly simpler utility

function for our analysis. From equation (6) and (7) we can readily see the two effects of differential dynamic incentives. The first is due to the rate of dispersion of product technology. As v_i, the retention rates for the firm, increases the firm raises its consumption of resouces R_i and its consumption of innovation effort through increased bonus prices P_i. Clearly with everything else the same, differences in dispersion rates due to differing habits of advertisement of production by innovators will result in different input mixtures. However, even if they were the same and social gains to innovating were entirely absorbed by the firm, the mix of e and R by two otherwise identical firms in the two countries would be different because the incentive parameter a_i differs across countries we have a situation akin to countries facing different production functions or different inputs.

Referring back to equation (4) we note that as U.S. workers are willing to work harder for the same reward a_U is smaller than a_J. Therefore $\tilde{e}_U$ will be larger than $\tilde{e}_J$ for any given P. Moreover, R_U will also be larger for any world price π because combined with the larger quantity of labor effort input, resource marginal products are higher. However from equation (5), (6) and (7) it is obvious that the increases are non-proportional. Thus the future rewards to current production present in our U.S. job market increased production and thus marginal rate of transformation changes. Thus we have two effects, one due to differential diffusion rates and the other to differential incentives and both are simply because of the way in which workers must present themselves in the future, and because the reaction of both firms and individuals is nonlinear.

Here it is appropriate to pose several questions about the theory. First, in a steady state where each firm pays workers a differential amount depending on their reputation, would not the firm be paying the same regardless of country? The answer is "no" for two primary reasons. First with differential diffusion rates the firms incentive pay as opposed to base pay will necessarily be different. Our theory here is based on the marginal difference. Second, without complete markets in human capital, *i.e.*, the ability to sell ones future labor resources, a practice banned by most countries in the last century, compensation at different points in time need not have the same utility. This is reflected in our incentive effect a_i and since it is not a marginal cost of the firm, will result in different allocations.

Second, we have restricted ourselves to viewing only one good. With many goods, will not factor price equalization take place, eliminating the so[illegible] of distortion in our model? In other words can the market price these differential incentive and dispersion effects so as to eliminate the equilibrium differences in marginal transformation rates

that we found? Again the answer is "no" because the essential ingredient, firm loyalty and firm commitment, by tradition, makes the two types of labor supplying e_J and e_U different factor inputs. With different factor inputs there is no necessary equalization.

To complete this part of the analysis we briefly restate the usual social planner problems and optimality conditions. A social planner, given a choice of allocations will maximize world output by allocating e and R such that in the two countries:

$$MRT_J = R_J/e_J = R_U/e_U = MRT_U. \tag{8}$$

Whenever (8) is satisfied we are on the contract curve and where it is not a Pareto improving allocation is possible. This is true regardless of the dynamic considerations since at each point in time compensation may be paid across countries. Calculating the free market mix of e and R across countries we find:

$$\frac{e_J/R_J}{e_U/R_U} = \left[\frac{a_J}{a_U}\right]^{\frac{\alpha^2}{(2-\alpha)(2-\alpha-2\beta)}} \left[\frac{1+r-v_J}{1+r-v_U}\right]^{\frac{1}{2-\alpha-2\beta}}, \tag{9}$$

which is equal to 1 only when $a_J = a_U$ and $v_J = v_U$. That is the two sources of distortion in our market are the only impediments to the achievement of world equilibrium.

In equation (9) the ratio may be greater or less than one. Since we have hypothesized that diffusion is much more rapid in the U.S. than in Japan, $v_U < v_J$ and therefore the second term of equation (9) is less than one. However, because of the incentive effects of good current performance through their influence on future income, $a_U < a_J$. Therefore the first term is greater than one. Consequently it is an empirical question whether or not japan is more effort intensive or more resource intensive than the U.S. in the absence of subsidies. Nevertheless the intensities are in all likelihood different.

Finally we ask if these market inperfections are correctable by permitting limited but substantial labor flows between countries. Though it is possible if the labor markets tend to merge in the sense of traditional characteristics, we suspect that in practice these differences would persist. For a fusing of the two markets the implicit rules of the market would have to fuse. In other words the U.S. must become more like Japan in providing traditional lifetime employment or japan more like the U.S. in settling base wages based on a free market assessment of past success. Without this merging of the dynamic incentives it is doubtful that a market solution would work.

III. Optimal Industrial Policy

The previous section demonstrated that culturally different labor markets could lead to inefficient resource allocation. To correct such an inefficient allocation would be quite simple for a social planner. For example, by international production agreements we could design a series of taxes, subsidies and lump sum transfers conditioned on any given level of output I which would use less e and R in both countries. Such a plan would be optimal in the Paretian sense and could, if desired, take into account the social benefit and cost of I. In practice however such an agreement is very difficult to achieve, particularly if there exists room for moral hazard problems and if it is difficult to decide on the aggregate lefel of I. In our theoretical example we supposed that one input e was difficult to measure, a clear candidate for introducing moral hazard into an international agreement. Therefore, we will focus on industrial policy as a unilateral program.

Suppose, under the observation that rates of transformation are different for different countries, japan decides to make itself more like its competitors in the development of innovations by creating MITI. This organization has the power to create incentives for innovative activity in order to return the equilibrium allocation to the contract curve. Obviously this may be achieved either by subsidizing innovative success and thereby reducing the marginal cost of effort, or by providing resource subsidies. We will examine each and compare their allocative outcomes to the optimum.

For a resource subsidy, assume that Japan lowers the cost of R to firms engaged in the production of I by a factor λ. That is these firms pay the price $\lambda \cdot \pi$. From the previous section we find that the quantities of e and R chosen by Japanese firms are :

$$\hat{R}_J = C\left[\frac{1+r}{1+r-v_J}\right]^{\frac{2}{2-\alpha-2\beta}} \left[a_J\right]^{\frac{-\alpha}{2-\alpha-2\beta}} \left[\lambda\pi\right]^{\frac{2-\alpha}{2-\alpha-2\beta}} \tag{10}$$

$$\hat{e}_J = D\left[\frac{1+r}{1+r-v_J}\right]^{\frac{1}{2-\alpha-2\beta}} \left[a_J\right]^{\frac{(1-\beta)}{2-\alpha-2\beta}} \left[\lambda\pi\right]^{\frac{-\beta}{2-\alpha-2\beta}} \tag{11}$$

where D is a constant. Clearly (10) and (11) show that reductions in λ lead to increased use of R and e and a more than proportionate increase in R. It is then straightforward to find the optimal subsidy when the optimum is taken as a position

on the contract curve. From (9) we have :

$$\lambda^* = \left[\frac{a_J}{a_U}\right]^{\frac{-\alpha^2}{(2-\alpha-\beta)(2-\alpha)}} \left[\frac{1+r-v_J}{1+r-v_U}\right]^{\frac{-1}{2-\alpha-\beta}} \tag{12}$$

If Japan is relatively effort intensive then λ^* will be less than one and a subsidy to the use of resources will induce more productive activity and a move towards the contract curve. At the same time, the increased world demand for the input R and the increased world supply of I will change relative prices away from I. Thus π will increase and the U.S. will produce less I. In this sense the Japanese subsidy is forcing out some U. S. production, however not by enough to prevent a compensating sum to be paid.

If in the absense of restrictions and subsidies japan is more resource intensive in the production of innovations, then a success subsidy or effort subsidy would be warranted. Thus our MITI would pay $1-\theta$ percent of the success subsidy P leaving the firm to pay θ percent. By straightforward calculation again we find that lowering θ below 1 increases the use of e relative to the use use of R and increases the production level of I. Moreover we find that the optimal θ is :

$$\theta^* = \left[\frac{a_J}{a_U}\right]^{\frac{\alpha^2}{2-\alpha-2\beta}} \left[\frac{1+r-v_J}{1+r-v_U}\right]^{\frac{2-\alpha}{2-\alpha-2\beta}} \tag{13}$$

Therefore, it is clearly possible for a single country to move towards a contract curve by selectively subsidizing research and development or any other activity in which local productive activity is conducted under different rules than international activity. International agreements could foster moves towards efficient allocations which benefitted both countries, but a single country could make this move unilaterally. If the country was large enough to affect market prices substantially due to the subsidy, other countries could be hurt by such a system, and the industry which is being hurt in the other country might characterize such a situation as unfair or predatory. In fact, the equilibrium with the subsidy may more closely approximate free market equilibria than the no subsidy equilibrium.

Ⅳ. Industrial Policy Planning

In the previous section we demonstrated that industrial policy may be designed and

used to achieve Pareto Optimal allocations on the contract curve when market structure would otherwise dictate suboptimal allocations. In this section we explore the properties of an industrial policy strategy which takes as its goal not world optimality but individual country optimality. Finally we propose a welfare improving response function which implies that the country not initially instituting an industrial policy would be well served if it countered foreign subsidies with similar domestic subsidies. Since many of these issues have been fully developed in the literature on duopoly theory, and there are many subtle issues about the nature of non−cooperative games which might be constructed, we do not propose to fully explore the topic of industrial policy strategies. Rather our purpose in this section is to illustrate in the context of our previous model that while industrial policy is justified on efficiency grounds, individual country optimization will probably lead to a suboptimal allocation which transfers income from the foreign to the domestic economy as a direct result of domestic policy.

We begin by completing the market structure of the previous section. Defining R_{ic} and I_{ic} as consumption by residents of country i and goods R and I respectively, and taking consumption of R to be a proxy for other goods produced with R, we posit the log linear utility function for country i consumption of:

$$U^i(I_{ic},\ R_{ic}) = k_i \ln I_{ic} + l_i \ln R_{ic} \qquad i = J,\ U. \tag{14}$$

We have implicitly made a separability assumption in (14) solely for analytical simplicity. Consumers are assumed to maximize (14) subject to the budget constraint

$$\frac{1+r}{1+r-v_i} I_{ip} + \pi R_i^* \geqq I_{ic} + \pi R_{ic} \qquad i = J,\ U. \tag{15}$$

where I_{ip} is total production of I by country P and R^* is gross receipts of sales of R net of that sold to produce I. The solution of the maximization of (14) subject to (15) yields demand functions for consumers of both countries. Imposing market clearing in both markets we obtain equilibrium prices as:

$$\pi = \left[F_0^{-1}(F_1 + F_2\lambda_U)\,\theta_U^{\frac{-\alpha}{2-\alpha-2\beta}} \lambda_U^{\frac{-(2-\alpha)}{2-\alpha-2\beta}} + F_0^{-1}(F_3 + F_4\lambda_J)\,\theta_J^{\frac{-\alpha}{2-\alpha-2\beta}} \lambda_J^{\frac{-(2-\alpha)}{2-\alpha-2\beta}} \right]^{\frac{2-\alpha-2\beta}{2-\alpha}} \tag{16}$$

where F_0, F_1 and F_2 are constants which depend on parameters of the utility functions,

production functions, r, $v_J v_U$. Clearly the equilibrium price is dependent upon the subsidies λ_U, θ_U, λ_J and and θ_J. Therefore in the course of manipulating the input mix to obtain an allocation on the contract curve, a country can exploit its market power as a non-insignificant portion of the market and influence prices to its own gain. Though this result was derived in the context of many specific production functions and consumption utility functions the point is clearly quite general. Though an individual firm might arguably have very little influence over the world price of cars, bicycles, television sets or semi-conductors, clearly both Japan and the United States can influence the world market price by influencing the total supply of these commodities.

It is then straightforward to verify that :

$$\frac{d\pi}{d\lambda_J} < 0, \qquad \frac{d\pi}{d\lambda_U} < 0 \tag{17}$$

or in other words an increased subsidy to the use of resource R (a reduction in λ) will result in more R demanded and an increase in the relative price of R. However, straightforward but tedious calculation reveals that when λ_J is lowered the production of I_J increases and the production of I_U declines.

To assess the effect of these results on individual country welfare we require the specification of country specific welfare functions. Suppose that each country's welfare is an increasing function of income and a decreasing function of the effort variable e_i. It is relatively easy to find such functions consistent with our previous individual optimization and a representative agent assumption even though for aggregate welfare such justification is not necessary. We write our welfare function for each country as :

$$\begin{aligned} &W^i = W^i(I_{ip}(\lambda_U,\ \lambda_J) + \pi(\lambda_U,\ \lambda_J)R_i^*,\ e_i(\lambda_i)) \\ &W_1^i > 0,\ W_2^i < 0,\ \pi_1 < 0,\ \pi_2 < 0,\ e_i^i < 0. \end{aligned} \tag{18}$$

Suppose that Japan is able to impose an industrial policy subsidy of the use of resources in innovations without the United States reacting. Then clearly a lowering of λ_J below 1 raises both I_{JP} and π and therefore raises income. However it also raises e_i. Thus an optimal $\lambda_J = \lambda_J^{**}$ can be found where :

$$\begin{aligned} &W_1^J(I_{JP2} + \pi_2 R_J^* + \pi R_J^*) + W_2^J e_J^J = 0 \\ &\lambda^{**} = \lambda^{**}(\alpha,\ \beta,\ k_J,\ k_U,\ l_J,\ l_U,\ r,\ v_J,\ v_U,\ a_J,\ a_U) < 1. \end{aligned} \tag{19}$$

Moreover, there is no reason to expect the optimal λ in (19) to be the same as the

Pareto optimum λ of equation (12) for the world economy. Indeed the entire literature on duopoly theory suggests that unless the welfare function W^J is designed to achieve the contract curve optimum, we will not find the two concepts of optimality equal. It therefore benefits Japan to adopt an industrial policy strategy in which there is an increase in income and a welfare gain accrued because in the sale of I and R Japan turns the terms of trade in Japan's favor. Moreover, if Japan happens to be particularly well endowed with R, it may wish to subsidize bonuses for innovative production and tax the use of R in order to reduce domestic usage of R in production. Once in place, industrial planning can take advantage of whatever market power a country as a whole possesses and therefore can potentially benefit the nation.

For the U.S. no reaction implies that both income and effort will change. Therefore net welfare change will be :

$$W_I^U(I_{UP1} + \pi_2 R_U^* + \pi R_{U_{\lambda_J}}^*)d\lambda_J + W_2^U(de_U/d\lambda_J)d\lambda_J. \tag{20}$$

It is easily verified that the first term I_{UP1} is negative and that the remaining terms are positive. Japanese idustrial policy forces a reduction in U.S. production of innovation goods which is welfare reducing but at the same time it frees U.S. resources for sale at the higher relative price, augmenting income and freeing some time spent in effort. Therefore the sign of (20) is not given by the theory.

However it is easy to construct examples for which U.S. welfare change given by equation (20) is negative. For example if the welfare value of effort were small, W_2^U close to zero, then it is quite plausible that the value of reduced production will exceed the increased value of the resource base R. If this is in fact the case then a response to Japanese policy will be welfare improving. In particular, a like subsidy of resource use would increase U.S. income and reduce Japanese production. Although the mix of factor inputs would necessarily be different, such a policy would in effect reverse the decrease in production due to Japanese policy. Exactly what the effect would be is conditional on the form of the welfare functions and the rules of the bilateral game. These issues deserve further study, particularly in the context of empirically specified models which faithfully account for some of the market dynamics.

In the case of single country policy then we find several possibilities. First the country imposing the policy will induce the production of more I and unequivocally increase the relative price π. For certain parameter values and welfare functions this will reduce the level of welfare in the other country since there will be a reduction in the other countries production of I. However, the changed terms of trade effect may

dominate and for other values of welfare functions we find that it is possible for industrial policy in one country to benefit both countries.

V. Condluding Remarks

In this paper we have explored some aspects of international markets in an attempt to rigorously analyze the effect of industrial policy of the kind followed by MITI and to recast the discussion of these issues in terms of incentive structures. Our basic premise was that we cannot expect labor markets to be characterized by a high degree of international mobility and labor markets in different countries, because they are set in the context of different cultures, traditions and tastes, and perhaps fundamentally different entities. Thus the dynamic incentive structure may not be the same across countries resulting in firms hiring what is essentially from their point of view different factors.

Our analysis led us to conclude that we could not usually expect Pareto Optimal outcomes even from otherwise competitive markets and that there was room therefore for improved resource allocation. Such allocation can take place by international agreement or by unilateral and systematic subsidy programs. However, we showed that at times it would benefit other countries if they would respond with intervention or planning and subsidy agencies of their own.

Our theory sets out a different view point from the context of the usual industrial policy debate. In fact, from this point of view a government need not be in the business of picking winners and losers in the future gorwth industry sweepstakes. Nor need it be in the position of considering employment or output as a zero sum game. Rather, our point of view is that when one examines the extra-market incentives which exist across economies it is very likely that these will differ in systematic ways. Since they do in fact differ, and there is no apparent market mechanism for equalizing them so long as countries are different entities, then welfare improving market intervention is possible.

The more commonly held notions about industrial policy, that they are originally instituted because the government feels that domestic producers are hurt by the local conditions in which they conduct business and that foreign workers and companies feel that they are being subjected to unfair competition may indeed have some basis in fact. Although there may be no evident market failure in the local labor or capital markets, it is quite likely that intrinsic aspects of labor and capital could be non-traded goods. On the other hand, if unfair competition is viewed as monopoly like behavior in world

markets, then indeed we find that can be supported by theroy. The truth and importance of the factors we have outlined above however clearly requires further theoretical and empirical investigation.

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