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INTERNATIONAL COMPETITIVENESS: IMPLICATIONS OF NEW INTERNATIONAL ECONOMICS

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1. Introduction

In recent years, concern has been expressed, in both popular and academic circles, about the competitiveness of the U.S. economy. The source for much of this concern has been, to a considerable extent, associated with the U.S. trade deficit and, related to this, the bilateral trade deficit the U.S. has sustained with Japan. Consequently, there has been much discussion and criticism of other countries' trade and industrial policies (particularly those of Japan and the European Community) on the grounds that U.S. exporters have had considerable difficulty increasing or maintaining market share abroad and that other countries' policies have given the U.S.'s competitors assistance in penetrating the U.S. market. This, in turn, has given rise to demands for more U.S. government intervention, particularly in what is seen as a key sector of the economy, the high-technology sector. Explicitly, there have been demands for "managed trade" (see, for example, Dornbusch (1990) and Tyson (1990)) which would involve establishing "rules of the game" for trade in certain sectors. The ultimate aim of "managed trade" would be to promote U.S. access to overseas markets (particularly, but not only, Japan) in return for continued, but controlled access to the U.S. market. Others have called for internal measures to increase the U.S.'s ability to compete in high-technology industries (see Jarboe (1985) and Tyson (*op.cit.*)). Such domestic intervention may involve, for example, subsidies to research and development (R&D) and other instruments of industrial policy.

This paper aims to provide a perspective on the desirability of such policy options as an aid to promoting a country's competitiveness. Specifically, we will discuss the insights that recent developments in trade theory offer in understanding the links between policy and competitiveness. There are, however, two points that should be noted as a preamble to the discussion. First, since competitiveness is not solely a concern of the U.S., we will attempt to

keep the discussion as general as possible. One only has to recall the not dissimilar concerns that were debated in the late 1970s regarding the UK's economic performance (see Blackaby, 1979) which focused on high levels of import penetration into the UK, labor relations, low investment, short-termism, the size of the public sector and so on. Second, in order to promote some consistency in the discussion, it is imperative that we define explicitly what "competitiveness" means. Without a clear definition, any overview of what trade theory can contribute will leave us, at best, talking at cross purposes and, at worst, saying nothing constructive at all on the competitiveness issue.

The paper is organized as follows: Section 2 defines the "competitiveness" problem and identifies what factors are most likely to determine a country's competitiveness. Section 3 considers what, if anything, traditional trade theory can offer in understanding the competitiveness issue. A general overview of recent developments in trade theory and what insights they bring to the competitiveness debate is presented in section 4, and section 5 discusses various policy options in the context of these recent theoretical developments. Section 6 summarizes and concludes.

2. Defining the Competitiveness Problem

While there has been a profusion of literature in recent years relating to U.S. competitiveness, it is difficult to find a useful definition of "competitiveness". This may be due to the fact that many commentators do not regard it as necessary to make explicit an appropriate definition, perhaps because it is obvious, or because "competitiveness" means different things to different people. Yet, in order to promote some consistency in our discussion, it is necessary to start with a clear definition in mind.

A concise definition of competitiveness is given by Fagerberg (1988) who defines it as:

> "the ability of a country to realize central economic policy goals, especially growth in income and employment, without running into balance-of-payments difficulties" (p. 355).

This definition is not inconsistent with others that have been found in the literature. For example, Hatsopolous *et al.* (1988) define "competitiveness" as:

> "....not simply the ability of a country to balance its trade, but its ability to do so while achieving an acceptable improvement in its standard of living...[Further] we would not regard the United States as competitive unless it was able to maintain a rate of growth in living standards that keeps pace with that in the rest of the world" (p. 299).

while from the business-school camp, Scott (1985) defines it as:

> "....a nation's ability to produce, distribute and service goods in the international economy in competition with goods and services in other countries, and to do so is a way that earns a rising standard of living." (p. 14-15)

There are perhaps three points worth emphasizing with regard to these definitions. First, competitiveness is primarily about economic growth. Second, according to these definitions, competitiveness is not explicitly about either market share issues or other indicators of industry or sector performance. These aspects of performance are only important insofar as they relate to economic growth. Third, competitiveness is a long-run issue: growth, by definition, is a path-dependent process such that the current allocation of resources in the economy will determine future standards of living. As McCulloch (1985) points out:

> "...some policies could increase market share...but may achieve these results *at the expense of future gains* in productive capacity, employment and national well-being." (p. 143) [Emphasis added.]

Armed with Fagerberg's (*op.cit.*) definition, one can turn to the question as to what determines a country's competitiveness. Traditionally, discussion of the determinants of competitiveness has focused on manufacturing cost comparisons between countries (Fagerberg, *op.cit.*). Thus, for example, the debate on the UK's deteriorating economy often emphasized high relative unit labor costs as a cause of de-industrialization in the UK. The assumption here is that, for a given (constant) mark-up onto final good prices, if a country's unit labor costs were relatively lower vis-à-vis other countries it would gain global market share which, in turn, would be expected to increase growth. Similarly, relative export prices would also reflect cost advantages.

All this appears obvious. There is one basic problem, however: changes in relative costs do not appear to correspond with expected changes in market shares. This was first noted by Kaldor (1978) and is sometimes referred to as the "Kaldor paradox". Specifically, Kaldor presented data on relative unit labor costs and unit export values for eleven major industrialized countries for the period 1963-1975 and compared them with changes in each country's global market share. He found that, in six of the eleven cases (which included the U.S., Japan, West Germany and the UK) rising (falling) relative labor costs or relative export values were matched with higher (lower) market shares.

Does the "Kaldor paradox" still hold? In order to answer this, data on normalized unit labor costs, unit export values and market share were obtained for West Germany, Japan and the U.S. for the period 1966-1985. Market share is defined as a country's share of total world imports. Relative export prices for each country are for manufacturing goods only, this data being drawn from the recent data set compiled by Lipsey *et al.* (1991). The data are presented

in Table 1 and are expressed as average annual percentage changes.

Table 1. Relative Costs and Market Shares for U.S., Germany and Japan: 1966-1985.

(Average annual percentage changes)

Country	Relative Normalized Unit Labor Costs	Relative Export Prices	Market Share
U.S.	-1.16	-1.66	-1.72
Germany	1.72	-0.80	0.62
Japan	2.18	1.44	5.04

Sources: Labor Costs: IMF Price Statistics, various.
Market Shares: IMF Price Statistics, various.
Export Prices: Lipsey *et al.*, 1991.

Conventional wisdom would lead us to expect that lower relative wages would be reflected in higher market shares. However, for all three countries, our *a priori* convictions are not upheld: market share appears to be positively correlated with changes in relative costs[1]. Similarly, relative export prices appear to be positively correlated with market shares for the U.S. and Japan, though not so for Germany. It therefore appears that the "Kaldor paradox" still holds:

[1] Of course, the direction of causality may be reversed i.e. as a result of declining productivity, wages have to fall to maintain market share. See Hatsopolous *et al.* (1988).

at least at this superficial level, relative cost data do not appear to tell us very much about a country's competitiveness[2].

If cost comparisons do not explain changing market shares for the most successful industrialized countries, what does? Useful empirical work comes from Fagerberg (*op.cit.*). Fagerberg specifies a theoretical model that relates the determinants of trade performance (relative costs, technological progress and investment) to GDP growth and tests it using panel data for 15 OECD countries for the period 1961-1983. In general, Fagerberg's results show that factors relating to technology and investment primarily determine medium and long-run differences in growth in market share and GDP across countries. Cost differences, in accordance with the data in Table 1 on the "Kaldor paradox", play a more limited role in explaining a country's competitiveness.

Fagerberg's econometric results appear to accord with more casual observation of the competitive challenges facing the U.S. economy[3]. These challenges have both an internal and external dimension. Internally, the U.S. has faced a productivity slowdown over the post-war period in a large number of sectors, the slowdown being particularly marked over the 1970s. The U.S. productivity slowdown has largely been associated with low investment, investment in the U.S. as a proportion of GDP over 1970 to 1980 being lower than in most other industrialized countries (McCorriston, 1992). Low investment in the U.S. can, in large part, be explained by the high cost of capital, low savings rates and other macroeconomic phenomena.

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[2] Further support for the inadequacy of relative price data in explaining market share can be found in Kellman (1983).

[3] See McCorriston (1992) for an overview of the U.S. competitiveness issue.

Despite the productivity slowdown, the U.S. has remained at the top of the productivity league (see Baumol *et al.*, 1989). Other countries have, however, converged on U.S. productivity levels. Part of this is due to higher investment levels in other countries, though R&D performance also plays an important role, particularly given that the source of the strongest challenges to the U.S. have come in the high-technology sectors. It is notable that R&D expenditure is now higher in Japan and Germany than in the U.S. (National Science Foundation, 1989). This gap in R&D expenditure is exacerbated when one looks at R&D spending on non-defense activities: data for 1987 show that non-defense R&D expenditure as a percentage of GDP was 2.8 percent in Japan, 2.6 percent in Germany and 1.75 percent in the U.S.

In sum, both general observation and econometric results based on stronger theoretical foundations appear to suggest that productivity growth (and its determinants, investment and technological progress) is the principal factor influencing a country's competitiveness. In light of this conclusion, we now turn to a discussion of traditional trade theory and what it can offer as an insight to the competitiveness issue.

3. Traditional Trade Theory and Competitiveness

The simplest way to study the effects of a country's deteriorating productivity performance in the context of traditional theory is to refer to a simple Ricardian model of trade. In this model, we assume that there are two countries, home and foreign. Labor is the only factor of production with total labor endowment for each country given by L and L* for the home and foreign country respectively. The amount of labor required in the production of individual goods captures factor productivity, and the wage rate is the appropriate reward to this

factor. Following Dornbusch *et al.* (1977), it is assumed that a large number of goods can be produced by both countries, the range of goods z being spread over the interval [0,1]. A country will produce a proportion of goods in this range, the extent depending on relative costs of production. As we shall see, changes in factor productivity will influence the range of goods each country will specialize in.

Relative costs of production are given by:

$$a(z)w \leq a^*(z)w^* \tag{1}$$

where a(z) is the labor requirement for producing z in the home country, a*(z) is the labor requirement for producing z in the foreign country and where w and w* represent costs of production in the home and foreign country, respectively. Re-arranging (1) we have:

$$\frac{w}{w^*} \leq A(z) \tag{2}$$

where A(z) equals a*(z)/a(z) and is shown in Figure 1 as the A(z) schedule. It is downward sloping: with lower relative wages, the home country will produce a larger range of goods.

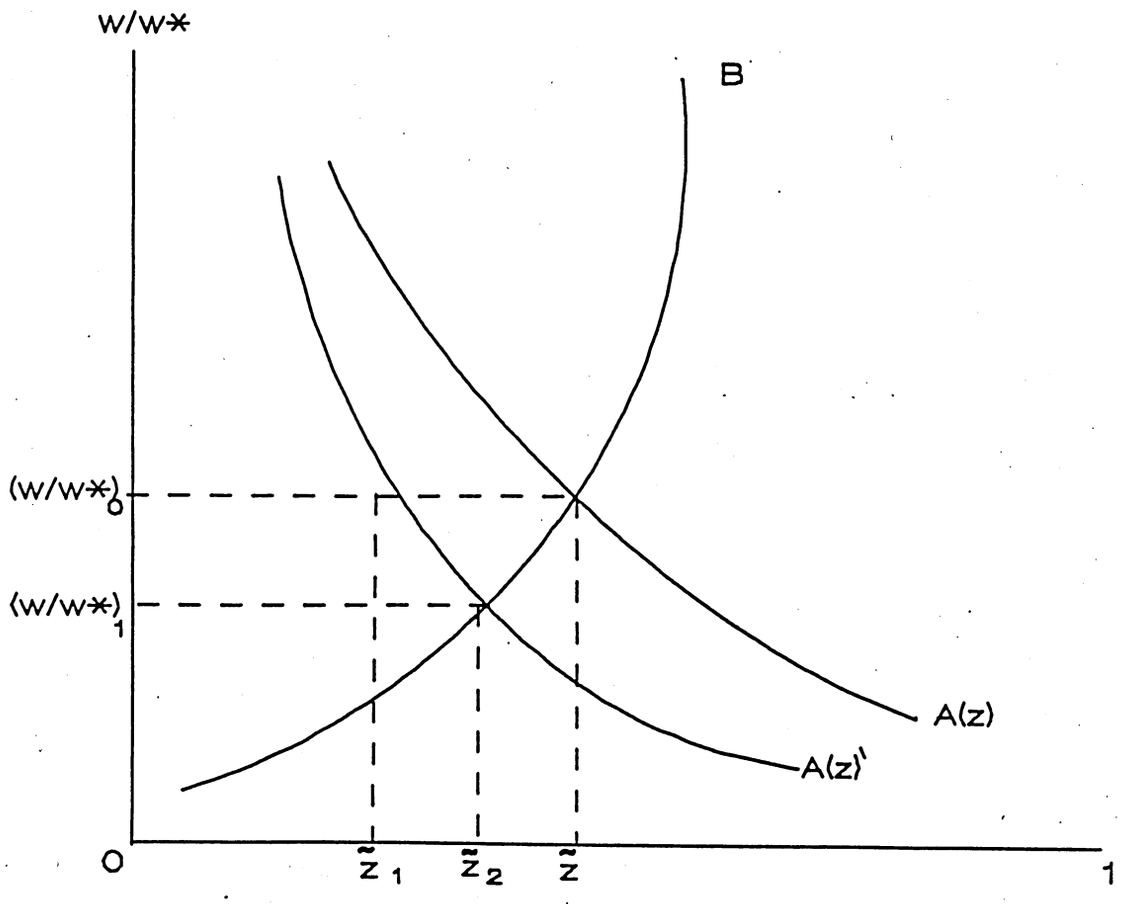
On the demand side, exports must equal imports. v(z) is the share of income spent on home goods and (1-v)(z) is the share of income spent on foreign-produced goods. Demand for exports then depends on foreigners' income (w*L*). Similarly, the demand for imports depends on home country's income (wL). The current account therefore balances when:

$$v(z)(w^*L^*) = (1-v)(z)(wL) \tag{3}$$

which, after re-arranging we obtain:

$$\frac{w}{w^*} = \frac{v(z)}{(1-v)(z)}(L^*/L) \tag{4}$$

Figure 1



This relationship is represented by the upward sloping schedule B in Figure 1 which shows that a higher demand for home goods will be offset by higher relative wages if trade is to remain balanced. Equilibrium establishes relative wages $(w/w^*)_0$ and the range of goods each country will produce. As shown in Figure 1, the home country will have a comparative advantage over the range $[0,\tilde{z}]$ while the foreign country will produce $[\tilde{z},1]$ goods.

It is now easy to see what happens when productivity uniformly improves in the foreign country. Productivity improvement implies $a^*(z)$ is now smaller. This shifts the A(z) schedule to the left as shown in Figure 1. If relative wages remain unchanged, the home country will now produce only $[0,\tilde{z}_1]$; relative wages, however, will fall to $(w/w^*)_1$ to offset this relative productivity deterioration leaving the country producing a smaller range of goods given by $[0,\tilde{z}_2]$

How does this analysis relate to the competitiveness debate? Note that from the Ricardian model presented above, the country still participates in trade despite its relative productivity weakness, it still gains from trade and consumers benefit from the productivity improvements in the foreign country via terms-of-trade effects. As far as traditional theory is concerned, therefore, competitiveness would appear to be largely a non-issue. Unlike companies, countries cannot go out of business even if other countries become more productive in *all* activities: even if a country is relatively less productive in all sectors, it will still have a comparative advantage in some activities.

In the context of the competitiveness debate, the concern with these changes must, therefore, have its source elsewhere. It may be due, for example, to the adjustment costs in running down $\tilde{z}_2 - \tilde{z}$ industries; but this is not different from traditional demands for protection. Perhaps more convincingly there must be a concern that there are certain attributes of the $\tilde{z}_2 - \tilde{z}$

industries that are in some way important to the home country that are not captured by traditional theory. Thus, what seems to be important as far as the competitiveness debate is concerned is the *mix* of industries in the home country rather than market share or profitability *per se*. This accords with McCulloch's (*op.cit.*) critique of the competitiveness debate:

> "Many concerns about competitiveness are actually concerns about changes in the composition of output relative to some unspecified ideal." (p. 142)

As Krugman (1991) suggests, this a more subtle view of the competitiveness issue than is generally understood.

What characteristics of certain (and, by implication, key) industries does traditional trade theory miss? There are perhaps three (related) features: first, these industries may be imperfectly competitive, generating rents that can increase national welfare over time; second, and perhaps more importantly, these industries may be R&D intensive and can thus generate spillovers for the rest of the economy; and, third, these industries may be characterized by increasing returns such that they provide inputs to other industries at decreasing costs over time. Such features are commonly associated with high-technology sectors and it appears that much of the competitiveness debate is concerned with the loss of these "strategic" sectors of the U.S. economy.

However, there is a final and perhaps more important point that traditional theory does not address. As we have seen from our definitions of competitiveness, the issue is one essentially concerned with growth. Thus, what is relevant is the dynamic (growth) effects of alternative compositions of output. Similarly, as regards policy options, it is the dynamic rather than the once-and-for-all effects of government intervention that is important. Thus, in this

respect, traditional trade theory is deficient since it is the dynamic effects that are critical in understanding the competitiveness issue.

4. Recent Theoretical Developments

The focus of this paper is on ascertaining how certain policy options can improve a country's competitiveness. As discussed in the previous section, the competitiveness debate is concerned with the mix of industries with particular concern raised over the loss of key high-technology sectors. Some recent developments in trade policy analysis would appear to address some of these problems since they attempt to accommodate some of the features common with these high-technology sectors. This literature is often referred to as strategic trade policy analysis. The term "strategic" here is mainly associated with the role that government intervention could play in influencing the game-theoretic interaction between competing (home and foreign) firms and thus, largely, refers to the oligopolistic nature of these industries. This literature shows that government intervention can give the home firm the equivalent of first-mover advantage such that rents can be captured from foreign competitors. These theoretical developments originated with Brander and Spencer (1983, 1985), an overview of which can be found in Krugman (1987a) and Baldwin (1992). However, while much of this literature deals with the oligopolistic aspects of high-technology industries, few studies have incorporated dynamic features, the notable exception being Baldwin and Krugman (1985) who incorporate learning-by-doing effects. The principal conclusion of the strategic trade policy literature has been to suggest that government intervention, through setting optimal values for import tariffs or export subsidies, can increase national welfare, although empirical studies have shown that the

likely gains are small (see Helpman and Krugman, 1989).

However, given our discussion of the competitiveness problem, this literature on "rent-shifting" policy does not offer appropriate insights into how policy can influence competitiveness. First, since competitiveness is concerned with the mix of industries, a general equilibrium perspective is required. Virtually all studies of strategic trade policy are partial equilibrium in nature, although Dixit and Grossman (1986) highlight the effect of targeting one industry on other industries using similar inputs. Second, given our definitions of competitiveness, ideally the focus of policy options should be on how policy affects growth. Strategic trade policy (in common with most trade policy analysis) identifies only once-and-for-all *level* effects. In the context of the competitiveness debate, trade theory should identify dynamic aspects i.e. the effects of policy on *rates of growth.*

Recent developments in the broad area of macroeconomic growth theory cast some light on these issues. These theoretical developments were spurred by work by Romer (1986) and Lucas (1988). The most complete and recent analysis of the interaction between growth and trade is found in Grossman and Helpman (1991b). Before discussing policy options explicitly, we outline below (albeit somewhat heuristically) some of the principle features of these recent developments that are relevant to understanding the links between policy and competitiveness.

(a) General Equilibrium

Given that we are concerned with the mix of industries, a general equilibrium framework is required. This will give an insight into the desirability of policies that target certain sectors of the economy. Typically, in recent theoretical work, there are three sources of economic activity: a sector that produces traditional manufacturing goods; a sector producing high-

technology goods; and an R&D sector that produces blueprints for new goods. All sectors use both human capital and unskilled labor. The R&D sector is relatively human capital intensive while the traditional manufacturing sector uses unskilled labor relatively intensively. The high-technology sector is more human capital intensive than traditional manufacturing but less so compared with the R&D sector.

(b) Intertemporal Choice

The current allocation of resources between sectors will determine future competitiveness. Specifically, preference for higher consumption now will lead to fewer resources devoted to R&D, which will slow down the rate of innovation. Since such choices are endogenous, they must be dealt with via an intertemporal consumer utility function.

(c) Endogenous R&D Activity

One of the most significant aspects of recent theoretical work in growth theory is to model innovation as the outcome of intentional activity by entrepreneurs seeking profits[4]. Of course, this idea is not new, Schumpeter having referred to this in the 1940s[5]. Endogenizing innovative activity is an improvement on traditional growth theory where technological progress was largely treated as being exogenous. This has implications for the discussion of policy: if technological progress is exogenous, government intervention - at least from a theoretical viewpoint - cannot influence it. Now that it can be treated endogenously, policy has a potential role in influencing the growth rate.

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[4] Some models focus solely on "learning-by-doing." See Lucas (1988) and Krugman (1987b).

[5] For an alternative treatment of Schumpeterian R&D activity, See Krugman (1990).

However, in the Schumpeterian tradition, when new products are developed, monopoly pricing can arise. This creates a distortion in the economy i.e. the volume of innovative goods available will be too low.

(d) Characteristics of R&D

There are several features of R&D in these models that are notable. First, on a point which Romer (1990) has emphasized, R&D output is non-rival in nature. Thus, the fact that someone uses a mathematical formula or a firm utilizes an engineering design does not stop others from using it at the same time. Further, R&D output will be (at least partially) non-excludable; there is nothing to stop others from using it. Thus, R&D plays two roles in these models: it creates new designs for innovative goods and it adds to society's stock of R&D knowledge. As Romer (*ibid.*) points out, with these features of R&D, an economy will be characterized by increasing returns to scale.

Second, technical progress in recent research usually takes one of two forms. The simplest one is where R&D adds to the number of innovative goods available. Thus, the production function used in this case is similar to Ethier's (1982) adaptation of Dixit and Stiglitz's (1977) consumer utility function. Given this feature of R&D activity, a result highlighted by Romer (1986) and Grossman and Helpman (1991b) is that private R&D leads to a sub-optimal level of innovation since entrepreneurs do not account for the contribution their R&D activity makes to the economy's stock of knowledge, i.e. entrepreneurs ignore the spillover benefits when making their decision to invest in R&D activity.

To a certain extent, however, this specification is undesirable since observation informs us that goods are improved over time. This is dealt with by Grossman and Helpman (1991a)

who allow for goods increasing in quality rather than in number. R&D activity is more sophisticated in this case. In seeking profits, entrepreneurs allocate resources to R&D in order to improve upon the highest quality currently available. If successful, the incumbent will cease production since consumers will prefer to buy the new higher quality good at the quality-adjusted price. However, the firm that innovates successfully knows that other firms will target R&D to up-grade this good and, in time, will make zero profit once displaced. Thus, in this model, endogenous R&D activity results in a quality ladder with goods being improved over time.

Grossman and Helpman (*ibid.*) show that, in this model, innovation can be too slow or too fast. There are three externalities which the private entrepreneur does not take any account of. First, he ignores that consumer surplus increases with the new higher quality good. Second, as before, there is the contribution that his R&D efforts make to the stock of knowledge. Third, there is the profit-destruction effect that arises when the incumbent's profits fall to zero if he successfully develops a higher quality good. The first two effects are positive; the latter negative. As Grossman and Helpman (1991a) show, the outcome depends on whether the incentive to allocate resources to R&D is too high. If so, the rate of innovation will be too fast; otherwise, as in the expanding variety case, the rate of innovation will be too low.

(e) First-Best Policies

Before discussing specific policy issues, it is clear from the above overview that there is a role for government. There are two distortions: monopoly pricing in the high-technology sectors and perhaps too little output emanating from the R&D sector. First-best policy is, therefore, a subsidy to counter the first distortion of insufficient volume of the high-technology good being available and an R&D subsidy to deal with the second. However, if there is too

much R&D activity which can arise in the quality ladder model, rather than a subsidy, a tax on R&D activity should be used.

Given the general framework which these theoretical developments provide, we are now in a position to deal with explicit policy issues: will R&D subsidies, industrial policy or trade policy improve a country's competitiveness?

5. Policy and Competitiveness

We utilize Grossman and Helpman's (1991b) framework for dealing with alternative policy options which are aimed at improving a country's competitiveness. The framework typifies a world consisting of two countries both of which allocate resources between the traditional manufacturing sector, a high-technology sector producing vertically-differentiated goods and R&D activity. Each researcher can take advantage of R&D activity in either country and, with incomplete specialization and factor price equalization, the rate of growth is common to both countries. As we shall see, the advisability of policy will, in some cases, depend on the pattern of comparative advantage in each country. Further, we deal with the case where technological progress involves higher-quality goods rather than an increasing number with the features of R&D activity as outlined above.

There are two factors of production: human capital and labor. Factor market clearing conditions are given by:

$$a_{LY}n_i\iota^i + a_{LX}X^i + a_{LZ}Z^i = L^i \qquad i = A,B \tag{5}$$

$$a_{HY}n_i\iota^i + a_{HX}X^i + a_{HZ}Z^i = H^i \qquad i = A,B \tag{6}$$

where X^i is output of the high-technology goods, Z^i is output of the traditional manufacturing sector, n_i is the number of higher quality goods in which country i holds a technological lead and

ι is research effort targeted at goods in country i. Thus, $n_i\iota^i$ is the aggregate amount of R&D activity targeted at products developed in country i. The corresponding a_{ij}s, (i=H,L,j=γ,X,Z) represent fixed unit requirements of each factor used in research γ, high-technology (X) and manufacturing (Z).

Solving for the aggregate output of X^i and Z^i we have:

$$X^i = \bar{X}^i + \bar{b}_x n^i \iota^i \tag{7}$$

$$Z^i = \bar{Z}^i + b_2 n^i \iota^i \tag{8}$$

where:

$$\bar{X}^i = (H^i a_{LZ} - L^i a_{HZ})/(a_{HX}a_{LZ} - a_{LX}a_{HZ})$$

$$\bar{Z}^i = (L^i a_{HX} - H^i a_{LX})/(a_{HX}a_{LZ} - a_{LX}a_{HZ})$$

$$b_x = (a_{HZ}a_{L\gamma} - a_{LZ}a_{H\gamma})/(a_{HX}a_{LZ} - a_{LX}a_{HZ})$$

$$b_Z = (a_{H\gamma}a_{LX} - a_{L\gamma}a_{HX})/(a_{HX}a_{LZ} - a_{LZ}a_{HZ})$$

Since, by assumption, X is human capital intensive and Z is labor intensive, we have $b_x < 0$ and $b_Z > 0$.

Commodity market clearing conditions depend on commodity shares:

$$P_X X = \sigma \tag{9}$$

$$P_Z Z = 1-\sigma \tag{10}$$

where X and Z are the sum of $(X^A + X^B)$ and $(Z^A + Z^B)$, respectively and equilibrium prices are given by:

$$P_X = \lambda(w_L^i a_{LX} + w_H^i a_{HX}) \tag{11}$$

$$P_Z = (w_L^i a_{LZ} + w_H^i a_{HZ}) \tag{12}$$

In the traditional manufacturing sector (Z), prices equal marginal cost of production but in the high-technology sector (X), prices can exceed costs by a factor λ since the new products create

monopoly profits for the successful entrepreneur. Substituting (9) and (10) into (11) and (12), then using (7) and (8), commodity prices can be expressed in terms of factor supplies and the innovation rate γ as given by:

$$w_L^i a_{LX} + w_H^i a_{HX} = \frac{\sigma}{\lambda(X + b_X\gamma)} \qquad i = A,B \tag{13}$$

$$w_L^i a_{LZ} + w_H^i a_{HZ} = \frac{1 - \sigma}{(Z + b_Z\gamma)} \qquad i = A,B \tag{14}$$

(13) and (14) can be represented diagrammatically for a given rate of innovation γ, as shown in Figure 2. The XX line represents equilibrium in the market for the high-technology good and the ZZ line represents equilibrium for the traditional manufacturing good. XX is steeper than ZZ since it uses human capital relatively intensively. With full employment, factor endowments and the innovation rate determine the equilibrium output of both goods as given at point A. With incomplete specialization, factor prices are equalized in each country.

The relation between innovation and the costs of R&D (c) is given by the line $\gamma\gamma$. All points along this line satisfy:

$$w_L^i a_{L\gamma} + w_H^i a_{LH} = c \qquad i = A,B \tag{15}$$

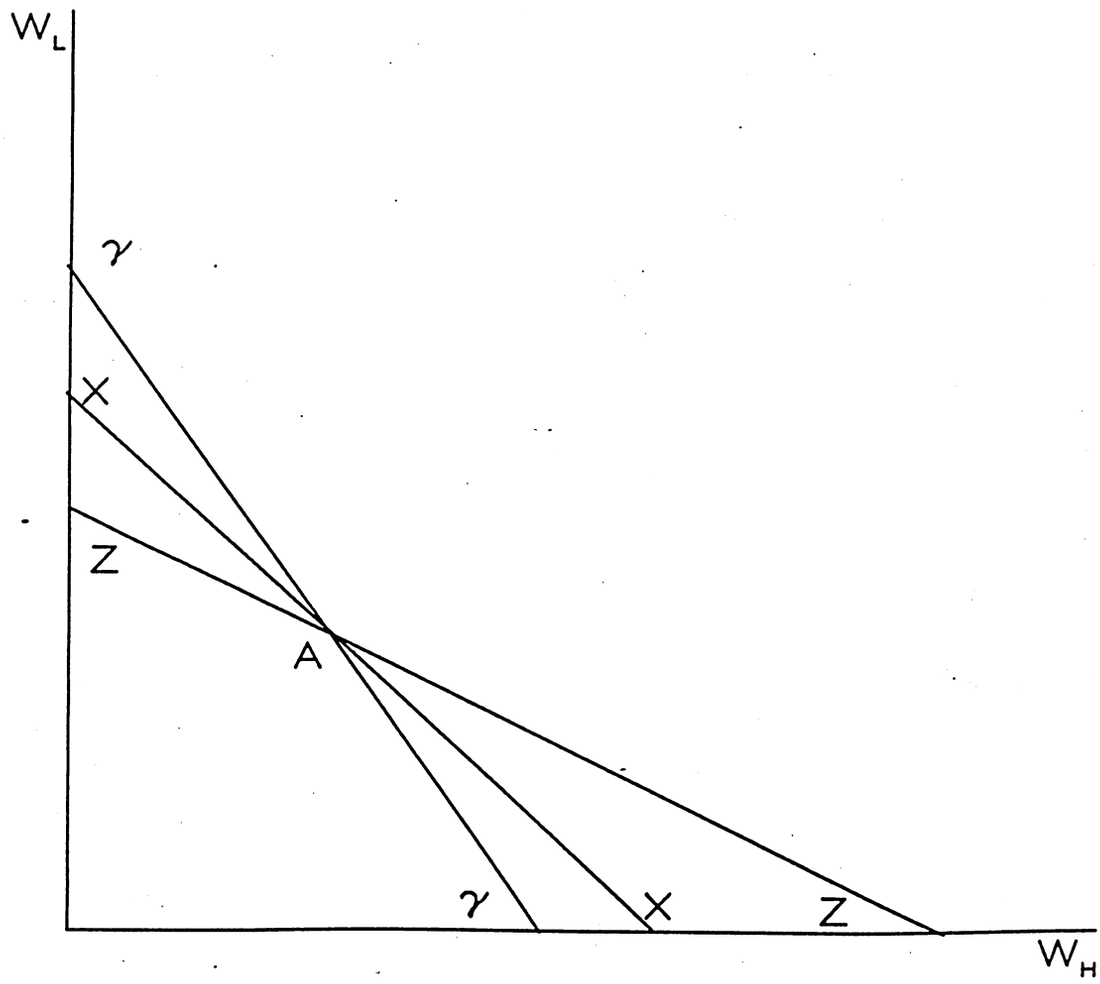
It is steeper than the other two lines since it is the most intensive user of human capital.

R&D activity is, of course, endogenous. Firms are valued according to their expected profit stream. A typical firm owns the technology for manufacturing a new improved product and it possesses market power in the supply of this product. The value of the firm therefore equals the present value of its profits:

$$V(t) = \int_t^{\infty} e^{-R(\tau,t)}\pi(\tau)d\tau \tag{16}$$

where V represents the value of a firm and $R(\tau,t)$ represents the discount rate from time τ to t.

Figure 2



The entrepreneur expects a reward of V on his research effort if he develops a new good. He therefore engages in product development unless the cost of R&D exceeds the expected gains. We are now in a position to consider various policy options.

(a) R&D Subsidies

Suppose, in line with some demands, the government in country A subsidizes R&D so that the private cost of R&D activity in country A falls. As a result of this policy, the composition of output changes in each country. The R&D sector in country A expands as a result of the subsidy and correspondingly contracts in country B, though the aggregate rate of innovation increases (Grossman, 1989 and Grossman and Helpman, 1991b, Chpt. 10). From the sum of (7) since b_x is negative, total output of the high-technology good (X) falls. However, the foreign country now produces a larger fraction of the world's output of the high-technology good. This arises since the effect of the R&D subsidy in country A encourages R&D activity which thus draws human capital from its high-technology sector. Expansion of the R&D sector in country A is, therefore, at the expense of its high-technology sector. In the foreign country, however, since R&D activity falls, this releases human capital which is employed in the high-technology sector.

Grossman (*op.cit.*) argues that this scenario could partially explain why Japan has captured a greater share of the world market in high-technology goods. Evidence shows that government funding of R&D in Japan is lower than in other major industrialized countries. For example, in 1986, the percentage of total R&D funded by the Japanese government was 19.6 percent but was 48.3 percent in the U.S. Corresponding figures for Germany, France and the UK were 37.5 percent, 46.1 percent and 42.2 percent, respectively (Grossman, *op.cit.*). Consequently, the logic

of the argument is that Japan allocates more of its skilled labor to the high-technology sector and less to original R&D.

In sum, an R&D subsidy would, in this scenario, increase growth in *both* countries though the subsidizing country would produce a smaller fraction of the high-technology goods.

(b) Production Subsidy

As suggested earlier, there have been demands for a more activist industrial policy in the U.S. (Jarboe *op.cit.*). The use of production subsidies (say, in the guise of government procurement) may be an integral part of such a policy. Would they be desirable?

Suppose country A offers a production subsidy of ϕ_X^A to the high-technology sector with no corresponding subsidy ($\phi_X^B = 0$) in country B. The effective price is now:

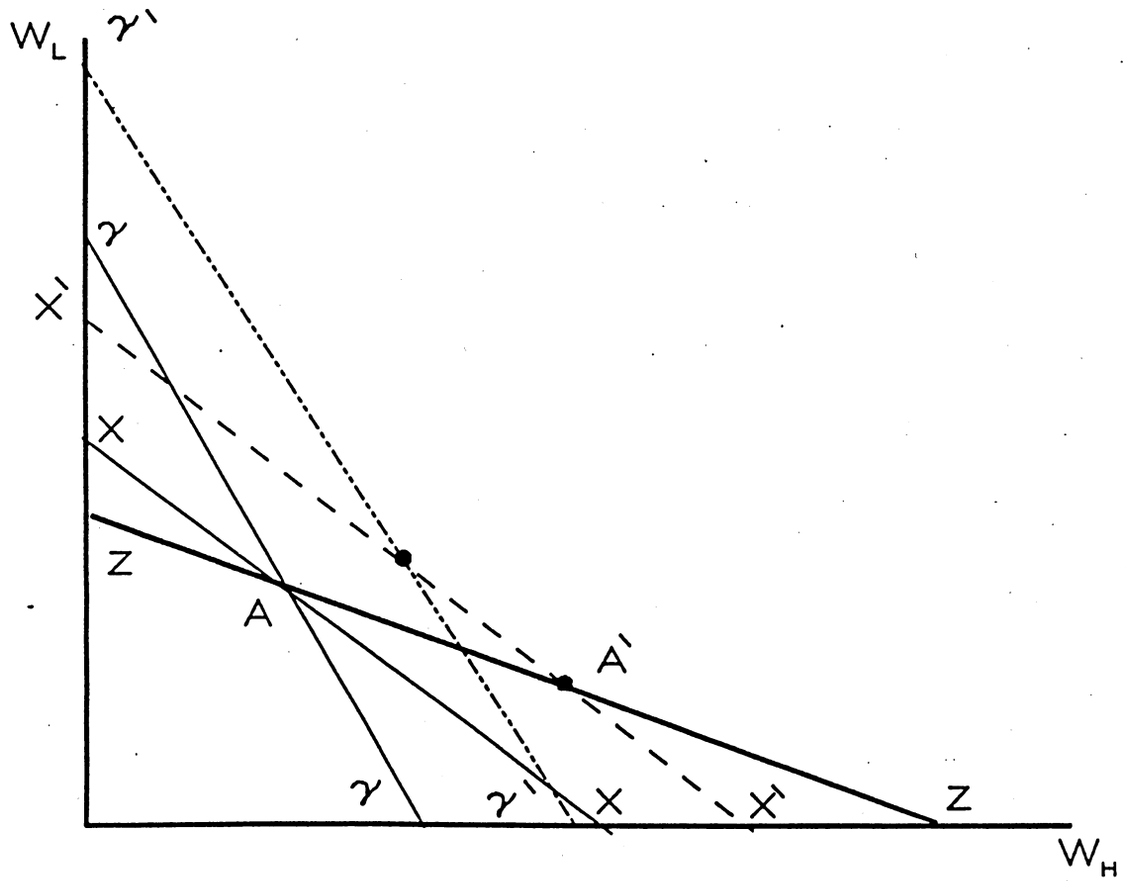
$$P_X = \frac{\lambda(w_L^i a_{LX} + w_H^i a_{HX})}{1 + \phi_X^i} \qquad i = A,B \tag{17}$$

so that (13) is now given by:

$$w_L^i a_{LX} + w_H^i a_{HX} = \frac{\sigma(1 + \phi_X^i)}{\lambda(\overline{X} + b_X\gamma)} \qquad i = A,B \tag{18}$$

The production subsidy has two effects. On the one hand, it increases the profitability of R&D thus influencing (16); on the other hand, expansion of the high-technology sector will increase the cost of R&D. This arises since the production subsidy shifts the XX line out as shown in Figure 3 resulting in an increase in w_H and a fall in w_L. Since w_H increases by more than the subsidy (as shown by the parallel shift equal to $(1 + \phi_X^A)$ of the $\gamma\gamma$ curve) a lower rate of innovation occurs. This applies to both countries despite the expansion of the R&D sector in the foreign country. Thus, the production subsidy expands country A's high-technology sector but at the expense of lower of lower growth.

Figure 3



By the same mechanism, a production subsidy to the traditional goods sector will increase growth. The expansion of the traditional sector shifts ZZ to the right. R&D costs subsequently fall and growth increases, though the high-technology sector will contract in the process.

These examples highlight the importance of adopting a general equilibrium framework for understanding the effects policies may have on a country's competitiveness. What is important is the resource the targeted sector uses intensively. Since the high-technology sector and R&D activity compete for a similar bundle of resources, expanding one of these sectors occurs at the expense of the other. Traditional manufacturing and R&D activity, however, appear as complements in this general equilibrium framework.

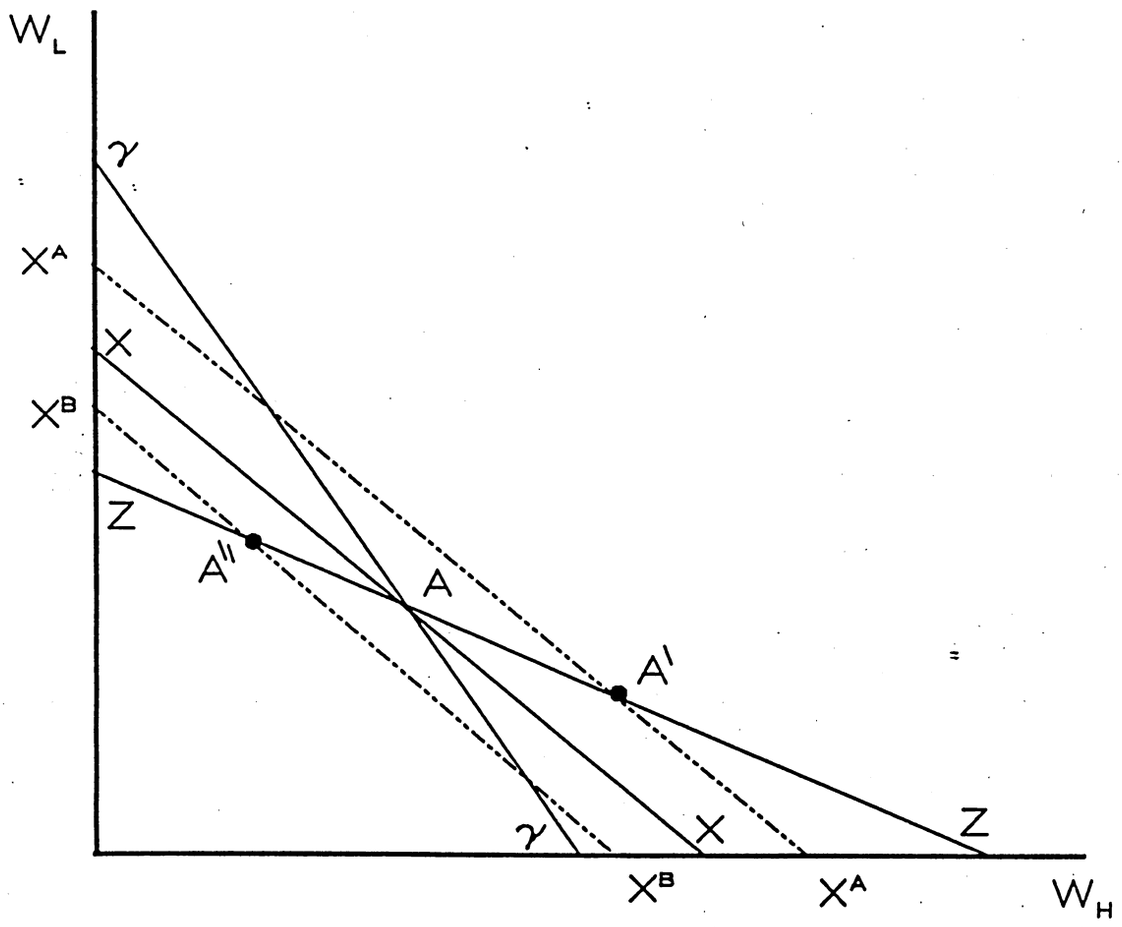
(c) Trade Policies

Perhaps the most common feature of the current competitiveness debate comes in the demand for the use of trade policy instruments either in the form of export subsidies or import tariffs or their equivalent in other forms of trade restrictions. Again, will such policies improve competitiveness?

Consider the case of an import tariff on high-technology goods imposed by country A. This shifts XX outward in country A and, simultaneously shifts XX inward for country B as shown in Figure 4. Again the mix of industries changes in each country along lines already discussed; but what happens to the rate of innovation? There are offsetting forces: in country A, the cost of innovation rises, while in country B it falls. Grossman and Helpman (1991b) show that the net effect depends on which country has a comparative advantage in R&D.

Consider the component parts of a tariff in country A. On the production side, an import tariff has the same effect as a production subsidy; the expansion of high-technology output raises

Figure 4



the cost of R&D. The tariff also increases prices to consumers in country A which lowers demand for high-technology goods which, other things being equal, lowers the cost of R&D. The net effect on growth thus depends on which of these effects dominate. If the spending effect dominates, then high-technology output will fall and, on balance, the rate of innovation will increase. Thus, if a country has a comparative disadvantage in high-technology goods, then the global rate of innovation will increase as a result of country A's trade policies. If, however, it has a comparative advantage in R&D, trade policy will lead to a lower growth rate.

What are the key features that arise from this discussion of policy options to improve a country's competitiveness? First, if one views competitiveness as ultimately being concerned with economic growth (see Section 2), then resources allocated to R&D worldwide are necessary to keep growth going in both countries. In this context, it is important to understand the general equilibrium aspects of targeting specific sectors in each country. Then many of the effects of government policies become intuitive. Two further aspects are worth noting: first, the effects of a country's policies can be transmitted worldwide, various policies in one country affecting the allocation of resources in both countries. This raises the question as to how one country should respond to another country's policies. This is related to the second point. With R&D spillovers between countries, each country benefits from R&D activity in its competitor country. Thus, it may be desirable for a country to remain passive even if the other country is pursuing an activist policy vis-à-vis its high-technology sector.

Ultimately, however, one should be interested in the welfare implications of such policies. Unfortunately, the welfare effects are ambiguous. Since we have focussed on scenarios where R&D is characterized by quality improvements, in the steady state, there is the possibility of too

much innovation. However, as long as the initial incentive to invest in R&D is not too great, welfare will increase as the rate of innovation increases. Against this, however, policies may simultaneously affect the monopolistic distortion, in some cases exacerbating it, in others not. Since the welfare effects associated with the rate of innovation and the monopolistic distortion may offset each other, it is difficult to comment unambiguously on the desirability of these policy changes on welfare grounds.

6. Conclusion

This paper has offered a perspective on how alternative policy options may affect a country's competitiveness. A key feature of our discussion has been to draw upon an explicit definition of "competitiveness" which has determined the appropriate theoretical framework upon which to draw our conclusions regarding policy. Since competitiveness is ultimately concerned with growth and not specifically market share or other indicators of industry performance, the important consideration is to understand the dynamic - rather than static - effects of alternative policies i.e. how policies influencing the current allocation of resources affect the future well-being of a country's citizens.

There are three main points that arise from our discussion. First, it is clearly important to consider the links between policy and competitiveness in a general equilibrium framework. A sectoral focus may advocate an increase in market share for a particular sector but this may occur at the expense of drawing resources away from other sectors that will ultimately reduce the country's growth rate. Second, policy intervention may be justifiable in particular sectors if the aim is to increase growth, though the welfare implications can be ambiguous. Finally, if

other countries are following interventionist policies, it is not necessarily the case that other countries should respond in kind. With the results of R&D being available across national boundaries, passive countries may benefit from government intervention abroad. The introduction of policy instruments may lead to a deterioration in a country's competitiveness.

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