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DESIGNING POLICIES TO OPEN TRADE

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ABSTRACT

In this paper we consider recent proposals to auction U.S. import quotas, using the funds so obtained to encourage relocation out of the protected industries. We argue that the information available to the government, or lack thereof, is a critical factor in understanding these policies. In a world of full information, it makes little sense to use auction quotas rather than tariffs. Similarly, it is unclear why an elaborate program of temporary protection is needed, rather than immediately opening trade and compensating people with an income transfer. When the government has limited information, however, these policies become quite sensible and may even be optimal.

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1. Introduction

The increased use of "voluntary" export restraints (VERs) on international trade, rather than tariffs, has allowed supplying nations to capture the quota rents through higher prices for their exports. Recent policy proposals have called for the auction of U.S. import quotas, allowing the U.S. treasury to obtain the revenues instead. The funds so obtained could be used to encourage relocation of workers out of protected industries, with the goal of reducing and eventually eliminating the protection. This type of policy was initially analysed by Feenstra and Bhagwati (1982), and brought into the U.S. policy arena by Hufbuaer and Rosen (1986), Lawrence and Litan (1986) and Bergsten *et al* (1987).[1] The latter authors estimate that rents from existing U.S. quotas on steel, machine tools, sugar and dairy as $5.15 billion, while lower estimates of $3.7-4.7 billion are provided by Parker (1987). At a time of high budget deficits in the U.S., this potential source of revenue has attracted Congressional and media attention.[2] Elsewhere, quotas have been auctioned in the last few years by the governments of New Zealand, Australia, Taiwan, Brazil, Pakistan, Singapore and India.

These policies are in part a political compromise between the government, firms and workers, which may account for their popular appeal, but can they be given a solid economic justification? In this paper we shall argue that the information available to the government, or lack thereof, is a critical factor in understanding these policies. In a world of full information, it makes little sense to use quota auctions rather than tariffs. Similarly, it is unclear why an elaborate program of temporary protection is needed, rather than immediately opening trade, and compensating individuals with income transfers. When the government has limited information, however, these policies become quite sensible and

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1 See also Bhagwati (1988, pp. 118 and following).

2 Media examples are Newsweek, January 12, 1987, p. 40; The Wall Street Journal, February 6, 1987, p. 40; and Business Week, March 9, 1987, p. 27. Congressional discussion of quota auctions is summarized in Bergsten *et al* (1987, chap. 1).

may even be optimal.

In the first part of our paper, we discuss quota auctions. Mathematical economists have in the last decade developed techniques for analysing auctions in general.[3] But there seems to have been little communication between the mathematical and trade economists. There exists an unexploited gain from trade. We shall show in section 2 and 3 that the theoretical analysis can be used, at a quite practical level, to supplement the recommendations of Bergsten *et al* (1987). We examine how well quota auctions serve as information-revelation devices, and we offer some suggestions on how quota auctions should be designed.

In the second part of our paper, we discuss that optimal design of trade and domestic policies, under incomplete (asymmetric) information. When agents in the economy have information that is private to themselves, they can have an incentive to misrepresent this information so as to shift policies in their favor. For example, the exact losses due to trade liberalization are best viewed as the private information of workers and firms, and are not directly observed by the government. If the government asked individuals what their losses are it would certainly get exaggerated responses. Under such circumstances, we know from the Revelation Principle that the government can safely restrict its attention to "incentive compatible" policies, which induce workers and firms to truthfully reveal their information.[4] In sections 4 and 5, we shall see that optimal policies which take into account the informational constraints resemble the actual proposals discussed above, and differ from those obtained with complete information. Conclusions and directions for further research are discussed in section 6.

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[3] This work is surveyed by McAfee and McMillan (1987), Milgrom (1985, 1987, 1989), and Wilson (1987).

[4] According to the Revelation Principle, any allocation resulting from policies which induce lying can be replicated by a truth telling policy. See Myerson (1979).

2. Auctions as Information Revealing Devices

Why auction import quotas; why, for that matter, are auctions used at all? Why does Sotheby's auction a Van Gogh, rather than simply putting a price tag on it? The obvious answer is that Sotheby's does not have enough information about the potential buyers' willingness to pay for the painting to be able to price it satisfactorily; the auction yields a higher return for Sotheby's than fixing a price. An auction, in other words, is fundamentally a device for revealing and aggregating information. Thus an analysis of auctions must recognize that information is dispersed and incomplete.

Empirical trade economists find it difficult to estimate the protective effect of any given import quota. The government setting the quota faces a similar informational handicap. In elementary trade theory, tariffs and quotas are equivalent; but if information is incomplete it is impossible for the government to compute the exact tariff equivalent of any given quota.

Bidders in quota auctions likewise have informational problems. At the time of bidding, they can only make informed guesses about the future market demand and cost conditions that will determine how much profit they can earn from having an import license. Let us model the bidders as each having different, partial bits of information about the true value of a quota license; a bidder's estimate is on average correct, but in any particular case it could be too high or too low. [5]

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[5] More precisely, the analysis being developed here assumes that the *common-value model* applies to quota auctions. That is, there is some true but, at the time of bidding, unknown value of a quota licence, V. If the bidders' estimates of this true value are denoted v_1, v_2, ... then the assumption is that the v_i's are independent draws from some commonly known distribution $H(v_i \mid V)$ (Wilson 1977). In practice, bidders might differ not only in their information but also in their ability to extract profit from an import licence; the bidders' valuations might be *affiliated* (Milgrom and Weber, 1982). Most of the results to be discussed in section 3 apply to this more general case. Note, however, one sense in which the models do not precisely fit the quota auctions. In the models, either an indivisible item is auctioned, or several units are auctioned but each bidder wants only one unit (as in Milgrom 1985). Bidders in quota auctions bid quantities as well as prices.

The bidders decide their bids using what they know about the value of winning. A phenomenon melodramatically named the winner's curse now arises. Suppose all bidders bid amounts that, based on their own value estimates, would yield reasonable profits if they won the bidding. Then the winner will typically make a loss. The highest bidder is the one whose estimate is the most optimistic. Winning conveys bad news; it tells the winner that his rivals' value estimates are lower than his. The winner is the bidder who most overestimates the value of winning.

A rational bidder anticipates the winner's curse when choosing his bid. He does this by basing his bid not only on his value estimate, but also on the presumption that his value estimate is higher than anyone else's. When this presumption is false, it is costless, for he will not win the bidding in that case. When the presumption is correct, it prevents unpleasant surprises after winning. Thus rational bidding in the face of the winner's curse involves bidding cautiously, well below what one's own information indicates is the value of winning. The idea of the winner's curse, and of bidding conservatively so as to escape it, underlie most of the results to follow.

Any auction, then, is a device for revealing information, for the bids reflect the bidders' estimates of the value of winning. Quota auctions are often discussed as a method for revealing the size of the protective effect of a quota (Takacs, 1988). How accurate is the information provided by the auction? Because of the winner's curse, bid revenue underestimates the quota's protective effect. But a remarkable and subtle theorem (due to Wilson, 1977, and generalized by Milgrom, 1979) says that the extent of underestimation becomes smaller as the number of bidders rises: if there is enough bidding competition, the information revealed is almost perfect. More precisely, if a single item is being auctioned and information about its true value is sufficiently dispersed among the bidders, then the selling price converges to the true value as the number of bidders becomes arbitrarily large. Thus, with a large number of bidders, the selling price is equal to the true value even though no individual in the economy knows what this true value is and no communication

among the bidders occurs. The bidding process serves to aggregate the bidders' separate pieces of information.

However, if the number of bidders is small enough that the bidding is imperfectly competitive, the bids incorporate some profit for the bidders; the winning bid is systematically below the true value of the quota. Two conclusions follow. First, in assessing the protective effect of he quota, some correction factor must be added to the bids to compensate for the small number of bidders, or else the protective effect will be underestimated. Second, in designing the auctions, it may be possible for the government to use tricks to stimulate the bidding competition and drive up the bids; some such tricks will be discussed in the next section.

How small is a "small" number of bidders? Conversely, how many bidders must there be before the bidding is effectively perfectly competitive? This is an empirical question; some evidence comes from the analogous case of U.S. Treasury bill auctions. The results of Cammack (1985) indicate that the number of bidders for T-bills is small enough for the cautious bidding induced by the winner's curse to show up in the data. In particular, Cammack finds that the average auction price was significantly less than the next day's secondary-market price, and that the profit from bidding in the auction increased with the dispersion of opinion among the bidders. The number of bidders is not stated, but they consist of government-authorized dealers, as well as commercial banks, large corporations, and investment funds. Since there are typically about 40 dealers (Stigum, 1983), there must be more than 40 bidders. Evidently, 40 is a "small" number of bidders in terms of the previous discussion.

How many bidders would there be if the U.S. government auctioned import quotas? For some, but not all, items one might expect bidders to number in the hundreds, so that winner's curse effects might be relatively small.[6] But since most of the policies to be

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[6] Under the current quota system, the number of licensed importers is about 500 for cheese, 160 for steel, 400 for footwear, and 40 for raw sugar (Bergsten *et al*, 1987, p. 43).

discussed in the next section are easy to implement, they are justified even if the potential gains are small. In addition, even if the winner's curse does not arise, some form of auction is preferable to the administrative allocation of quota licences. As emphasized by Anderson (1988), a quota auction (like a tariff) achieves an *arbitrage efficiency* by equalizing the rents earned on each unit imported. He finds that the actual allocation of quotas in the U.S. dairy industry does not satisfy this condition, leading to a substantial deadweight loss relative to an auction with the same level of imports.

3. Design of Auction Quotas

Suppose now that the number of bidders in a quota auction is small enough that their expected profits from participating in the auction are positive.[7] Then the design of the auction matters, for it is possible for the government to regain some of these profits. This section summarizes some theorems that identify ways of extracting some profits that would otherwise be left to the bidders.

A uniform-price auction yields more revenue than a discriminating auction (Milgrom and Weber, 1982; Milgrom, 1985).

In the New Zealand quota auctions, for example, each successful bidder pays the price; the auction is a discriminating auction. In the Australian quota auctions, by contrast, all successful bidders pay an amount equal to the lowest accepted bid; the auction is a uniform-price auction. Theory says that the latter raises more revenue. This is because, as noted, bidders discount their own information when they bid, so as to avoid the winner's curse. In the discriminating auction, the price a successful bidder pays depends

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[7] We will assume, however, that production of the good in question takes place under perfect competition. As discussed by Krishna (1988a,b), oligopolistic pricing of a good can substantially affect the quota rents, and therefore, the amount available from a quota auction.

only on his own bid. In a uniform-price auction, the price depends in addition on others' bids. Thus, the price he pays reflects others' information as well as his own; he can afford to discount his own information less when choosing his bid. Each bidder is rationally less cautious in the uniform-price auction than in the discriminating auction, so the bids are higher.

The U.S. government uses both discriminatory and uniform-price auctions to sell Treasury bills, though usually the former. Some Treasury studies have compared the performance of the two auction forms. The results, summarized by Baker (1976), are consistent with the above theorem: the uniform-price auctions seemed to generate the higher revenue.

An open auction yields more revenue than either a discriminating or a uniform-price auction (Milgrom and Weber; 1982, Milgrom, 1985).

An open auction is the auction form typically used in the sale of antiques and art: bids are called openly, and bidders can raise their bids if they want to stay in the running. The argument is essentially the same as above. More information is conveyed by the open auction than the uniform-price auction, so the winner's-curse discounting factor is still smaller and bids are higher. It is, perhaps, corroborative of this theorem that private-sector sellers usually choose open auctions rather than sealed-bid auctions (Cassady, 1967, p. 66). It is usually the public sector that uses sealed bidding.

An open auction need not be so undignified as to have people shouting out their bids; it could be run on linked computers, for example. The essential feature is that all bidders know the current best bid and can raise their bids whenever they want.

The open auction does have one disadvantage, however. Our maintained assumption is that the bidders are not able to coordinate their bids. The dispersion of information makes collusion more difficult than in simple oligopoly models (McAfee and McMillan, 1988). But

if the bidders can somehow overcome the hindrances to coordination, they are more likely to succeed in colluding in an open auction than in a sealed-bid auction, as Bergsten *et al* (1987) pointed out. This is because a cartel must give its members an incentive not to seek short-run gains by deviating from the prescribed bidding behavior. The sanction against deviation is the threat of retaliation, in the form of high bids. With sealed-bid auctions, retaliation can come only in subsequent auctions, for the deviation is not observed by the other bidders until after the auction. In open auctions, in contrast, retaliation can occur immediately, so the threat of retaliation is more persuasive (Milgrom, 1987).

Mead (1987) gives some evidence that collusion is more frequent in timber-rights auctions when the government uses open auctions than when it uses sealed-bid auctions. Is collusion likely in import-quota auctions? Further evidence from timber auctions suggests not. Mead, Schniepp, and Watson (1983) found that, in those auctions in which only local firms bid, prices did not go much above the reserve price. But when there was competition from firms from outside the region, prices were typically two or three times the reserve price. Collusion, apparently, was not possible with outsiders bidding. It is presumably at least as difficult to organize collusion in quota auctions, involving nation-wide competition, as in the timber auctions with nonlocal bidders.

The government would increase its revenue from the quota auctions by imposing reserve prices (Myerson, 1981; Riley and Samuelson, 1981; Milgrom and Weber, 1982).

There is a trade-off. The advantage of a reserve (i.e., minimum) price is that in some cases it forces bidders to bid higher than they would in the absence of the reserve price. The disadvantage is that on some occasions bidders' estimates of the value of winning are so low as to leave a part of the quota unsold at the reserve price. The reserve price is optimally set at the level that balances these two effects. The foregoing result says that maximizing expected revenue requires that the reserve price be set high enough

that, with positive probability, not all the licences will be sold. A conflict exists, however, between raising revenue and opening trade. In the event that the reserve price is a binding constraint, trade is restricted more than under the original quota.

The government should require royalty payments based on the returns from selling the items subsequently imported under the quota (McAfee and McMillan, 1986).

Suppose it is feasible for the government to monitor the uses to which the awarded quotas are put, so that it can implement a royalty scheme based on the realized profitability of the import licences.[8] Then the total payments to the government will be higher than under a simple payment-equals-bid scheme. This is because more aggressive bidding is induced; the difference among the bidders at the time of bidding become less important in determining their bids. But royalties introduce another consideration. How profitable a quota turns out to be depends in part on the winning bidder's efforts after he receives the import licence. This incentive effect limits the extent of royalties. The higher the royalty rate, the smaller the share of his profits the licence-holder will retain, and so the less effort he will make to generateprofits from the licence. Thus the optimal royalty rate is computed as a trade-off between the first effect - generating high bids - and the second - creating perverse incentives for the licence-holder.

The government should routinely publicize any information it has about the likely profitability of holding a quota licence (Milgrom and Weber, 1982, Milgrom, 1985).

As we have seen, the winner's curse induces cautious bidding. By publicizing information, the government reduces the uncertainty and therefore causes the bidders to discount their own information less. Government information could include research on

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[8] There are obvious practical difficulties in this which is may or may not be possible for the government to overcome.

trends in world prices or domestic demand, or plans about the government's own future trade policies. Sometimes the revealed information will lower the bidders' predictions of the value of a quota licence, and so induce lower bids. On other occasions, it will make bidders more optimistic. Because of the winner's curse, the latter effect outweighs the former; on average the policy of releasing information generates higher bids.[9] Econometric analysis of oil-rights bidding data by Hendricks and Porter (1988) shows that bidders with superior information do indeed bid higher on average than uninformed bidders. For art auctions, Ashenfelter (1989) finds that auctioneer's pre-auction estimates, which are made public, are good predictors of actual auction prices.

Finally, notice that all of these methods of generating increased revenue for the government from the quota auctions also generate better information about the size of the quota's protective effect, because the total value of the quota to the bidders is an upper bound on the expected total bid revenue, given rational bidding.

4. Sources of Asymmetric Information

Raising quota revenue is only the first step of the liberalization packages proposed by Hufbauer and Rosen (1986), Lawrence and Litan (1986) and Bergsten *et al* (1987). The revenue raised in quota auctions can be used to encourage relocation out of protected industries, after which the protection itself can be lowered. We now consider how the information which is available to agents (or lack thereof) affects the design of adjustment policies.

It is important to distinguish two types of asymmetric information which can arise. The first is asymmetric information between *private* agents in the economy, which can lead to failure in the market between them. For example, in the presence of implicit labor

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9 The government cannot, of course, have a policy of releasing information only when it is good news, for then not releasing the information is tantamount to revealing it.

contracts, it might be thought that any unemployment resulting from opening trade would justify some protection. Whether or not this occurs, however, depends on whether the original equilibrium is constrained Pareto optimal.[10] Fernandez (1988) finds this to be true in a model of implicit contracts with terms of trade uncertainty, leading to no role for trade policy, whereas Riordan and Staiger (1988) reach the opposite conclusion with adverse selection in the labor market. Conflicting conclusions on the scope for government intervention have also been reached in models of infant industry protection.[11]

We will focus here on another source of asymmetric information: that which arises between the *government* and other agents. Our strategy is to suppose that the economy begins with some trade restrictions, given historically. It now wants to dismantle the restrictions, but to do so in a way that is voluntarily acceptable to a fraction of the population. If this action benefits all individuals, then Pareto gains are obtained. More generally, political constraints will dictate that some portion of individuals gain. The difficulty arises in identifying the gains or losses to individuals, which can be expected to be private information to themselves and not observed by the government. Conversely, agents at home or abroad may not be able to identify the true preferences (or "type") of the government, so that the government can hold some private information. We shall begin with a case where the asymmetry in information may be most acute: across national boundaries.[12]

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10 Dixit (1987a,b,1989) examines whether the competitive equilibrium is constrained Pareto optimal in a two sector model with adverse selection, or moral hazard. He argues that in models where some insurance markets are missing, it is essential that the reasons for this be made endogenous.

11 Contrast the results of Grossman and Horn (1988) and Bagwell and Staiger (1989).

12 One of the best examples of an international asymmetry in information is the "transfer pricing" problem, in which a government attempts to tax a multinational based on its profits earned in a local facility, but the multinational has better knowledge of intra-firm input prices. Prusa (forthcoming) determines the incentive compatible taxation scheme for this problem.

5. Optimal Design of Trade and Domestic Policies

5.1 *Asymmetric Information Between Countries*

Why do the VERs exist in the first place? The political economy and trade literature has debated this question for some time, and there is not a single answer.[13] One reason for their use arises when the political pressure for protection is private information to the home government. For example, in the U.S. an industry seeking import relief can apply to the International Trade Commission (ITC), which makes a recommendation to the President. The ITC operates under various guidelines in making its decisions, such as whether or not the domestic industry is "injured" by imports, and the reasoning is made public. The executive branch, however, bases its decision on an interagency committee chaired by the Office of the U.S. Trade Representative, and the deliberations are not made public. Baldwin (1985, p.195) states: "As a consequence of this procedure, both those favoring and those opposing import relief in a particular case tend to believe that unjustifiable political factors rather than sound economic reasoning determined the outcome of the case."

In this setting, trading partners may question the validity of an importing country's need for protection. This is especially true if the importing country is large enough to affect world prices and obtain a terms of trade gain through its policy actions. Then that government would have an incentive to seek high trade barriers, claiming that the domestic industry is suffering, when in fact the barriers serve only to promote home interests at the expense of foreigners. To resolve problem, it is possible to determine "incentive compatible" trade policies, in which the domestic government has no incentive to overstate (or understate) the need for protection. We find that:

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13 Baldwin (1988) begins his survey with this precisely this question. For two answers see Deardorff (1987) and Hillman and Ursprung (1988).

For a large country, transferring a portion of the rents from trade restrictions back to foreigners is incentive compatible (Feenstra and Lewis, 1987)

The intuition behind this result is quite straightforward. By transferring some of the tariff revenues or quota rents back to foreigners, the domestic country is effectively paying for the right to restrict trade. This will be worthwhile only if it faces genuine pressure from some industry, so that the political benefit from shifting income towards this industry exceeds the cost, including the deadweight loss plus the transfer of rents abroad. For a large country, the transfer of quota rents eliminates the incentive to obtain a terms of trade gain through the trade restriction.

The *magnitude* of rents to be transferred depends on the initial situation. If we start at free trade and one country then restricts imports, a transfer of rents which *keeps* the trading partner at the free trade level of welfare will be incentive compatible. Only by coincidence would this transfer exactly equal the rents generated from the restriction, in which case trade restriction takes the form of a VER with foreign firms reaping the benefits. For smaller levels of protection, the transfer to foreigners would be less than the total rents generated. In this case the transfer could take place through the use of "tariff-rate quotas," which specify a certain quota level to which goods are imported duty free, after which a tariff is applied.

Returning to our theme of quota auctions, their use in the U.S. would very likely violate incentive compatibility, since the U.S. is a large enough buyer to affect prices in many of its import markets. Put differently, the availability of this source of revenue could be attractive enough that there would be little incentive to proceed with liberalization in the affected industries. Lawrence and Litan (1986, chap. 5) propose that one-half of the revenues from U.S. quota auctions should be returned to exporting countries, particularly the least developed. Feenstra (1989) calculates that a larger amount would have to be returned to foreigners to maintain incentive compatibility, leaving $0.67-1.55

billion available to the U.S. This amount is much less than the total available through auction quotas (the estimates in section 1 range from $3.7-5.15 billion), but could still finance a significant program of worker adjustment within the U.S. In the next section we examine the specific features of domestic adjustment programs.

5.2 *Asymmetric Information Within a Country*

Industries facing a reduction in their tariffs, or elimination of quota protection, will typically have this action phased in over a number of years. For example, section 203 of the Trade Act of 1974 specifies that "To the extent feasible, any import relief provided pursuant to this section for a period of more than three years shall be phased down during the period of such relief."[14] This commitment to decrease the import protection is not entirely credible, however, since the next sentence of the Trade Act allows for extensions: "Any import relief provided pursuant to this section...may be extended by the President, at a level of relief no greater than the level in effect immediately before such extension, for one 3-year period if the President determines...that such extension is in the national interest."[15] In some cases the continuation of protection is made contingent on specific actions of reinvestment and modernization by domestic producers, as occurred with U.S. steel industry under the Trade and Tariff Act of 1984, section 806.

Beyond a simple desire to smooth the income streams of firms and workers, is there any rationale for phasing out protection slowly? To provide a benchmark, consider the case of a small country facing fixed international prices. The government wishes to maximize a social welfare function, and has full information on the utility functions and prices faced by individuals. Policy instruments available include taxes or subsidies on all goods and factors, but not necessarily lump-sum transfers of income. In this case we find that

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14 Trade Act of 1974, section 203(3)(h)(2), Public Law 93-618, Jan. 3, 1975.

15 Trade Act of 1974, section 203(3)(h)(3), Public Law 93-618, Jan. 3, 1975.

tariffs are *not* part of the optimal policy mix:

For a small country, social welfare is maximized by a system of commodity taxes which leaves producer prices at their free trade level (Dixit, 1985)

Income redistribution in the open economy is achieved with commodity taxation, but productive efficiency still holds, as in Diamond and Mirrlees (1971). This result is in line with the literature on trade and distortions, which would argue that tariffs are a second or third best way to redistribute income (Bhagwati, 1968, p. 32). To find an argument for eliminating tariffs only gradually, we need to drop some of the assumptions of the benchmark case.

Let us first suppose that some trade protection is initially in place, say in the form of tariffs. Since we are then starting in a distorted situation, we know that a deviation from first best policies (i.e. productive efficiency) might be desirable in future periods. However, at first glance there does not seem to be any reason to *continue* tariffs in the industry, since that would only serve to expand output and aggravate the distortion which already exists. An immediate elimination of tariffs would appear to be desirable on efficiency grounds. Surprisingly, this intuition is incorrect when we incorporate the career decisions of foresighted workers:

If an industry initially faces a positive tariff, and workers have mobility costs, the optimal second-period tariff can be positive (Leamer, 1980)

To understand this result, consider a two-period model with an exogenous tariff in the first period. Workers must choose their industry of employment in the first period, and after this, face mobility costs to moving. The government wishes to maximize the two-period GNP evaluated at world prices.[16] Suppose that tariffs are eliminated in the

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16 Leamer considers an alternative objective function which incorporates income

second period. This action would cause workers to shift out of the (formerly) protected industry to the unprotected industry, and therefore reduce wages in that sector. Anticipating this, foresighted workers who are making career decisions about which industry to enter in the first period would tend to choose the protected sector, where wages are initially higher. That is, the second period elimination of the tariff can lead to an *expansion* of first period output, through workers capturing the temporarily high wages. This expansion of output aggravates the existing distortion. It follows that the optimal second-period tariff can be positive, though it is always less than the first period tariff.

A related argument for gradualism arises when the government cannot credibly commit to eliminate protection. As discussed above, U.S. trade laws lack this commitment, and industries can also attempt to continue protection by lobbying to Congress and changing the law. The uncertainty surrounding the path of liberalization can be modelled as an endogenous probability that *future* tariffs will be used, say in period two. The possibility of future protection creates an intertemporal distortion, leading to excessive consumption in period one. The excessive consumption is offset by imposing a tariff initially. With many periods and learning about the "type" of government, it can also be shown that the tariff would eventually be eliminated:

If individuals are uncertain about the credibility of government reforms, a gradual reduction of tariffs is optimal (Calvo 1986; Engel and Kletzer 1987; Froot 1988)

The above arguments for gradualism relies on individuals having incomplete information about government actions.[17] Let us turn our attention to the converse case where the government cannot observe some characteristics of agents affected by the

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distribution, and this strengthens his argument for staged reduction in tariffs.

17 Along other lines, Matsuyama (forthcoming) examines an infinite horizon, complete information game of timing, in which the government uses the threat of future liberalization to induce the domestic firm to invest. He finds that optimal temporary protection may occur in an equilibrium, though this equilibrium is not renegotiation-proof.

liberalization. In recent years that has been much discussion about the possibility of eliminating agricultural trade barriers and dismantling domestic agricultural price support programs (see Economic Report of the President, 1987, chap. 5). In this context, is it possible and desirable to "decouple" aid to farmers from price supports, which distort relative prices and encourage excessive participation in agricultural sectors? The answer seems to be that complete decoupling is not advisable:

With informational constraints, efficient reorganization (complete decoupling) may be possible but it is generally undesirable (Lewis, Ware and Feenstra, 1989)

This pessimistic finding arises when workers possess private information about their skill levels, and their ability to find work in other non-agricultural sectors. To be politically viable any program to eliminate price supports must adequately compensate the workers for their losses and relocation costs. But workers command rents from their private information, which renders a complete decoupling of price supports too expensive for the government to fund. Instead, the use of (nonlinear) production subsidies in conjunction with income transfers becomes optimal, meaning that productive efficiency is not obtained due to the informational constraints.

5.3 *Pareto Gains From Trade*

Our final example of how incomplete information can affect optimal trade policy goes to the heart of economist's acceptance of free trade: the idea that gains for all individuals (Pareto gains) can be achieved. It has been known for some time that under the standard Arrow-Debreu assumptions, Pareto gains can be achieved by using lump-sum transfers within a country.[18] It can be expected, however, that governments would not

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[18] See the brief surveys by Chipman (1987, section 3) and Kemp (1987).

have the information needed to calculate these lump-sum transfers.[19] Dixit and Norman have recently argued that Pareto gains can be achieved with just a system of taxes on goods and factors, designed so that consumers face autarky prices while producers face free trade prices:

If producers are faced with free trade prices, while consumers face autarky prices for goods and factors, then the government raises non-negative revenue (Dixit and Norman, 1980, p. 79; 1986)

This result is analogous to our benchmark case in the last section, in that productive efficiency is maintained. Indeed, the objective of Pareto gains can just be considered an extreme form of the social welfare function in the last section, where now an increase in social welfare requires an increase in each individual's utility over autarky.

This striking result by Dixit and Norman seems to make Pareto gains informationally feasible, at least if the autarky and free trade prices for goods and factors can be observed, so that the requisite tax rates can be computed. We would like to suggest, however, that the implementation of Pareto gains is not as watertight as it seems, but that there are substantial informational difficulties still hidden in the Dixit-Norman scheme.[20] To see this, suppose that *all* individuals have some mobility costs in moving factors of production

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19 The needed information is the autarky and free trade vectors of prices for goods and factors (denoted by p^0 and p, respectively), and the autarky consumption and factor supply vector for *each* individual (denoted by x^{0h}, where negative components of x are factor supplies and $h=1,....H$). The autarky choices satisfy the budget constraint $p^0 \cdot x^{0h} \leq 0$. Then consider opening the economy to free trade with the lump-sum transfers $T^h = (p - p^0) \cdot x^{0h}$. The free trade budget constraint for an individual becomes $p \cdot x^h \leq (p - p^0) \cdot x^{0h}$, from which it is immediate that x^{0h} is still feasible. Moreover, summing T^h over individuals, we can use the technique of Dixit and Norman (1980, p. 79) to show that the aggregate transfer is non-positive, and therefore feasible for the government. This argument shows that it is not necessary to know the utility function of individuals.

20 Our discussion of mobility costs is closely related to the critique by Kemp and Wan (1986): the Dixit-Norman scheme of commodity taxes will not raise *positive* revenue unless the resulting production point differs from autarky.

between industries: these may be individual skill differences across industries; actual or psychic moving costs; time lost in unemployment or retraining, etc. The mobility costs can be modelled as individual transformation functions, which have as inputs the individual supply of each factor, and as outputs the effective supply to each industry.[21] The natural advantages from supplying all of one factor to a single industry could be captured by assuming that the transformation function is convex in outputs, but to stay in an Arrow-Debreu framework we shall suppose that it is concave.

To achieve Pareto gains in this economy it is necessary to apply the Dixit-Norman scheme of commodity taxes to these transformation functions, treating them just like the production function of a firm. This means that the outputs (factor supplies to each industry) must receive the prevailing free trade wages, while the inputs (raw labor or capital from an individual) should be taxed or subsidised to receive their autarky return. However, the prices of inputs are the shadow value of factors supplied by an individual, and these would not observed by the government. In particular, the government could not treat the *actual* wage earned by an individual as an estimate of their shadow price of labor, since this would create an incentive to choose a low paying job (e.g. unemployment) and be subsidized for the difference between this wage and earnings in autarky. Put simply, when we recognize that wages net of mobility costs for a given occupation differ across individuals, it may not be possible to calculate the subsidy needed to provide each person their autarky earnings without creating adverse incentives.

6. Conclusions

We have argued that the information available to governments is a critical factor in the design of international trade policies. This is seen most clearly in recent proposals to

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[21] This transformation function could itself be the result of past investments in human capital, as analysed by Grossman and Shapiro (1982).

auction U.S. import quotas, where the auctions serve as a devise to reveal the value of the quota licenses. Theoretical results in this area serve as a practical guide on designing an auction to obtain the highest revenue. These funds, like tariff revenues, can be earmarked to encourage relocation out of protected industries. The features of an adjustment plan will depend on the asymmetries of information. We have seen that a staged reduction in tariffs may be optimal; that productive efficiency may not be desired (in contrast to the case of complete information); and that the possibility of Pareto gains from trade may be compromised by incomplete information.

The research we have drawn from is recent, and much work remains to be done. We will mention two general areas of research. First, our discussion of trade and domestic policies dealt with those that were socially optimal, either from a global or domestic viewpoint. But it is equally important to understand how incomplete information affects the conduct of firms and governments in *non-cooperative* settings. For example, could the widespread use of VERs be explained as the outcome of a non-cooperative game between governments, perhaps because giving the quota rents to foreigners acts as a "signal" that the import restriction is really needed? Bagwell and Staiger (1988) do find a role for the *sharing* of quota rents across countries in a non-cooperative model, similar in spirit to the result with asymmetric information (section 5.1). Along other lines, Jensen and Thursby (1989) examine whether one country would want to mislead the other about its desire to impose trade barriers, and establish a reputation which could be useful in the future.

Second, our suggestion that Pareto gains from trade cannot be achieved deserves further attention. One approach is to examine more specific situations to see if gains are possible. Brecher and Choudhri (1989) consider a model where people rather than goods cross borders, but constrain the commodity taxes to not discriminate between people of different nationality located in the same country. Under this non-discrimination rule, they argue that *no* commodity taxation scheme can make every home national better off. Another approach is to expand the list of policy instruments. Since our discussion in section 5.3

suggested that mobility costs are a hindrance to achieving Pareto gains, it is natural to introduce Trade Adjustment Assistance (TAA) policies. The equity and efficiency properties of various TAA programs are examined by Diamond (1982), Brander and Spencer (1989) and Feenstra and Lewis (1989), though none of these authors find a plan which generates gains for all individuals. The empirical relevance of mobility costs is highlighted by Richardson (1982) and Bednarzik and Orr (1984), who report that TAA recipients often return to their former jobs after being unemployed, rather than switching industries. Determining whether it is possible to implement Pareto gains when workers have private mobility costs is an open, and important, area for research.

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