Redistribution in the Wake of Trade Liberalization — Help or Hindrance?

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Abstract

This paper generalizes the Pareto gains from trade literature by adding an explicit time dimension. In a two-stage general equilibrium model with a continuum of heterogeneous agents, we analyze the distributional implications of an anticipated trade liberalization. If the government attempts to achieve Pareto gains through redistribution after the reform but cannot commit to a particular policy beforehand, then Pareto gains may be impossible. The agents anticipate the intervention and underinvest strategically, thereby sabotaging the gains from trade. Ability-dependent, first-period subsidies/taxes on human capital acquisition would remedy the problem, but individual ability levels are private information not known to the government.
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1 Introduction

Market liberalization has been an essential ingredient of most recent economic reform programs and it is a dearly held conviction among economists that such reforms are beneficial. The profession usually concedes that an unfortunate few might lose in the presence of aggregate gains but is confident that this problem can — or at least could — be overcome by appropriate redistribution. In practice, compensation certainly plays a role in fending off the opposition forming against liberalization proposals.[1] Those segments of the population that stand to lose and therefore oppose the reforms tend to receive compensation of one form or another in order for the reforms to be accepted politically.

The idea that aggregate gains from trade can be redistributed to achieve an actual Pareto improvement has been analyzed in a series of contributions.[2] Using different forms of redistribution,[3] the Pareto gains from trade literature establish the result in static general equilibrium models. In this paper, we address the question of whether such redistribution leads to strategic behavior on the part of the agents. If people expect to be compensated for losses or to contribute towards payments in the wake of reform, will this influence how well they prepare for the liberalized economy? And if it does, could this strategic behavior potentially sabotage the gains from trade?

[1] See Magee (2001) and Gray (1995) for empirical studies of the trade adjustment assistance program in the U.S. and of the corresponding program in France respectively. Neary (1982) makes the theoretical case for such programs.

[2] These include Grandmont and McFadden (1972), Kemp and Wan (1972), Chipman and Moore (1972), Dixit and Norman (1980), Kemp and Wan (1986), Dixit and Norman (1986), Feenstra and Lewis (1991), Feenstra and Lewis (1994), Hammond and Sempere (1995), and Facchini and Willmann (1999) — for a survey see Facchini and Willmann (2001).

[3] Lump-sum transfers, Diamond–Mirrlees style commodity taxation, and non-linear taxation have been studied in this chronological order.

Indeed, once one acknowledges the dynamic nature of trade liberalization, the issue at stake is the time consistency, or rather subgame perfection, of such a policy mix.[4] Staiger and Tabellini (1987) question the time consistency of free trade when the government has distributional objectives but limit their analysis to one policy instrument: protection. This instrument is then also used[5] for distributive purposes, thus giving rise to the time inconsistency of free trade.

We take the commitment to free trade as given — possibly achieved through a commitment device such as the GATT/WTO — and explicitly consider redistributive policies proper. As Hammond (1999) shows in a closed economy framework, redistribution can lead to strategic underinvestment. This detrimental strategic effect also arises in the context of trade adjustment programs, as Bliss (1990) points out. Agents find it optimal to act strategically prior to the reform in order to influence their compensation (payments). In doing so they create a legacy[6] that affects not only themselves but everyone in later periods. The government, at that later stage, adjusts compensation to the given circumstances, and it is the private agents' anticipation of the government's reoptimization in the later period subgame that leads them to behave strategically in the first place. The interesting new question in the trade context is to what extent this effect might wipe out the gains from trade.

[4] See Kydland and Prescott (1977) for instructive examples of the time consistency problem. Their seminal work has influenced many areas of economics. In the trade context, contributions include Matsuyama (1990) and Tornell (1991) who analyze the time consistency of infant industry protection, Lapan (1988) who questions the time consistency of the optimal tariff, Leahy and Neary (1999) who investigate strategic trade policy when one or more actors are unable to commit, as well as Staiger and Tabellini (1987).

[5] One is tempted to say *misused*.

[6] Following the terminology introduced by Kaneko and Wooders (1986), Hammond (1999) calls it a "widespread externality".

To address this question formally we set up a two-stage general equilibrium model with a continuum of heterogeneous agents who differ in their abilities to acquire skills. We solve this model for the autarky case as a reference point and then compare it to free trade without redistribution to highlight the distributional consequences of trade liberalization. Before addressing the strategic effect, we briefly verify that Pareto gains are possible if the strategic affect is absent by assuming that the government only redistributes in the first period and credibly commits to remain inactive thereafter. If, on the other hand, the government is free to use lump-sum redistribution[7] in the second period and cannot commit to a particular such policy before the reform, then we can show that Pareto gains may be impossible to achieve. There exists a critical level of gains from trade, below which the strategic effect dominates and Pareto gains are impossible.

In response to this negative result, we discuss possible remedies. We show how ability-dependent subsidies and taxes on human capital acquisition in the first period can be used to avoid the strategic effect and achieve Pareto gains from trade. This solution, however, is informationally demanding and depends on the government's knowledge of individual agents' abilities. Given that these are private information and not publicly known, the government can at best approximate such a scheme.

The outline of the paper is as follows. In section 2, we set up the model. In section 3, we solve it for the autarky equilibrium before turning to free trade and its distributional consequences in section 4. Subsequently, section 5 presents our main result that Pareto gains from trade can be impossible to achieve through

[7]This is the conventional first-best policy instrument that features so prominently in the static Pareto gains from trade literature.

redistribution in the wake of the reform. In section 6, we discuss remedial policies and section 7 concludes.

2 The Model

This section sets up a two-stage general equilibrium model that captures the relevant effects without striving for generality. It could easily be generalized, of course, but we refrain from doing so for two reasons: on the one hand, a general model would not offer much additional insight; on the other, we establish a counter example that applies to any generalization.

Let there be a continuum[8] of agents $a \in [0, 1]$, where the index a denotes the agents' abilities to become skilled. Suppose that a is uniformly distributed on $[0, 1]$. In the first period all agents are endowed with one unit of a perishable consumption good. They can either consume their endowment in full or else decide to become skilled. The cost of becoming skilled depends on ability. Agent a has to give up $1 - a$ of her endowment to become skilled. That is, the most able agent ($a = 1$) can become skilled for free while at the other end of the spectrum the least able agent ($a = 0$) can only become skilled by giving up his entire endowment.

One may think of this stylized first period as the reduced form of a more complex setup where agents make both production and within-period consumption decisions. The crucial feature is that the agents decide on their human capital investment. Note that with only one good there will be no trade in the first period because we do not consider intertemporal trade.[9] Without trade in the first pe-

[8]The use of a continuum rules out strategic price manipulation and allows us to concentrate on dynamic investment behavior.

[9]The introduction of asset markets leads to similar strategic behavior, as Hammond (1999) has

riod, trade liberalization affects only the second period and can be thought of as a reform enacted between the first and the second period.

In the second period agents are endowed with one unit of labor — skilled labor if they became skilled and unskilled labor otherwise — that they supply inelastically. Each agent derives utility from the consumption of one high-tech good h and one basic good b according to the Cobb–Douglas utility function $u = x_h^\beta x_b^{1-\beta}$ where $0 < \beta < 1$. Their common intertemporal utility function is the product of the amount consumed in the first period and their second period utility — i.e., $U = au$ for those who become skilled and $U = u$ for those who do not.[10]

On the production side we have two sectors. We assume constant returns to scale so that the number of firms in each sector is immaterial. One sector produces the high-tech good according to the Cobb–Douglas production function $Y_h = L_s^\alpha L_u^{1-\alpha}$ where $0 < \alpha < 1$. The second (degenerate) sector uses only unskilled labor to produce the basic good. By appropriate choice of units, its production function is the identity function $Y_b = L_u$. This last assumption is made to give us a more tractable solution by eliminating one price — the price of the basic good will obviously equal the unskilled wage in any equilibrium with strictly positive production in this sector. Let us denote the price of the high-tech good by p and the wage for skilled labor by w. Furthermore, we normalize the price of the basic good — and with it the wage for unskilled labor — to one.

In addition to consumers and producers, there is the government that can carry out redistributive policies. We will discuss its objectives, the policy instruments

shown. We choose to focus on human capital instead, because wage differentials are of considerable interest in the trade context and considering both would unnecessarily complicate matters by requiring portfolio decisions.

[10]The intertemporal Cobb-Douglas formulation is chosen because it leads to a closed-form solution. Imposing additive separability over time would not substantially affect our results.

at its disposal and their timing, as well as the strategic interaction with the other agents below. Before doing so, however, let us turn our attention to the distributional effects of trade liberalization when the government remains inactive, that is, under *laissez faire*.

3 Solving the Model

As a starting point, we solve the model for the autarky case. This is not only a useful reference point, but solving this simple case allows us to point out some interesting features of the model that will prove useful when discussing other cases further down the road. Note that the results to be established in this paper apply to any initial restricted trade situation.

Maximization of the Cobb–Douglas utility function leads agents to spend a proportion β of their income on the high-tech good and the rest on the basic commodity. This gives rise to the following demand functions:

$$x_h = \begin{cases} \beta/p \\ \beta w/p \end{cases} \quad \text{and} \quad x_b = \begin{cases} (1-\beta) & \text{if unskilled} \\ (1-\beta)w & \text{if skilled} \end{cases}$$

Plugging back into the respective intertemporal utility functions yields the following indirect utility:

$$V(p,w) = \begin{cases} \mathcal{B}p^{-\beta} & \text{if unskilled} \\ a\mathcal{B}p^{-\beta}w & \text{if skilled} \end{cases} \tag{1}$$

$$\text{where} \quad \mathcal{B} = \beta^{\beta}(1-\beta)^{1-\beta}$$

Comparison of the indirect utilities for skilled and unskilled agents leads to a critical ability level of $a_c = 1/w$, the ratio of unskilled to skilled wages. Agents with $a > a_c$ will decide to become skilled whereas those with $a < a_c$ prefer to stay unskilled.[11] Given these decisions and the uniform distribution of abilities in $[0, 1]$, aggregate labor supply takes the form

$$L_u = a_c = 1/w$$

and

$$L_s = 1 - a_c = 1 - 1/w \tag{2}$$

The aggregate demand functions are

$$X_h = a_c\beta/p + (1 - a_c)\beta w/p = \beta(w - 1 + 1/w)/p \tag{3}$$

and

$$X_b = a_c(1 - \beta) + (1 - a_c)(1 - \beta)w = (1 - \beta)(w - 1 + 1/w)$$

On the production side, because of constant returns to scale, the output prices in any equilibrium with strictly positive production must equal unit costs. We already used this result for the basic sector when we normalized both the price of the basic good and the unskilled wage to one. For the high-tech sector, cost minimization leads to conditional factor demands

$$L_{u,h} = Y_h \left(\frac{1 - \alpha}{\alpha} w\right)^{\alpha}$$

[11] The agent $a = a_c$ is indifferent but having zero mass his/her decision can be assumed to go either way.

and

$$L_{s,h} = Y_h \left(\frac{1-\alpha}{\alpha} w \right)^{\alpha-1} \tag{4}$$

Imposing the zero profit condition then yields

$$p = \mathcal{A}^{-1} w^{\alpha} \quad \text{where} \quad \mathcal{A} = \alpha^{\alpha}(1-\alpha)^{1-\alpha} \tag{5}$$

To solve for the equilibrium, substitute equation (5) for p into equation (3), substitute X_h for the output into the conditional factor demand (4), and set demand equal to supply in the skilled labor market, i.e., set the result equal to the supply of skilled labor as given by equation (2). The resulting quadratic equation has two roots: one positive and one negative. Ignoring the negative root, we have an autarky skilled wage of

$$w^A = \frac{1}{2} + \sqrt{\frac{1}{4} + \frac{\alpha\beta}{1-\alpha\beta}}$$

Equation (5) then allows us to obtain the autarky price for the high-tech good, which is

$$p^A = \mathcal{A}^{-1} \left(\frac{1}{2} + \sqrt{\frac{1}{4} + \frac{\alpha\beta}{1-\alpha\beta}} \right)^{\alpha}$$

Note that the skilled wage is greater than one, representing the skill premium over the unskilled wage. We also see that it increases in α, meaning that a higher marginal productivity of skilled labor increases the wage for this factor. Both the wage of skilled labor and the price for the high-tech good increase in β, indicating that a stronger preference for the high-tech good leads to a higher price for this good and to a higher wage for the factor used exclusively in its production.

4 Distributional Effects of Free Trade

We now turn to a scenario where the country embraces free trade after the initial period has passed and does not carry out any redistribution. The standard small country assumption[12] allows us to work with a given world market price vector. We take the world price for the high-tech good to be $p^* = bp^A$. Taking a first world perspective, we will discuss the case where $b > 1$.[13] This is the case of an industrialized country with a low price for the high-tech good under autarky. When it liberalizes, demand for this commodity increases and its price rises from p^A to $p^* = bp^A > p^A$.

Since the country under consideration will specialize in the production of the high-tech good, production will be strictly positive in this sector. Then equation (5) gives us the skilled wage under free trade, which is

$$w^* = (\mathcal{A}p^*)^{1/\alpha} = (\mathcal{A}bp^A)^{1/\alpha} = b^{1/\alpha}w^A \tag{6}$$

From the fact that $b^{1/\alpha} > b$ we see that the skilled wage increases more than proportionally compared to the price increase for the high-tech good, a manifestation of the Stolper–Samuelson effect.[14]

[12] Since this assumption is usually understood to exclude even a passive influence on price, one should more appropriately speak of an infinitesimal country. We invoke it here to avoid the added complexity of finding the world market equilibrium price. This is a special case, of course, but the counter example we develop below obviously applies to the more general case, too.

[13] Our asymmetric model with its explicit high-tech and degenerate basic sector is clearly geared towards this case. If one wanted to discuss developing countries, one should probably focus on other sectors, such as agriculture and low-tech manufacturing. In our framework, in the case when $b < 1$, trade would lead to less human capital acquisition, aggravating the problems we will explore.

[14] A point taken up by Van Long, Riezman, and Soubeyran (2001) who use a similar model to focus on the labor market.

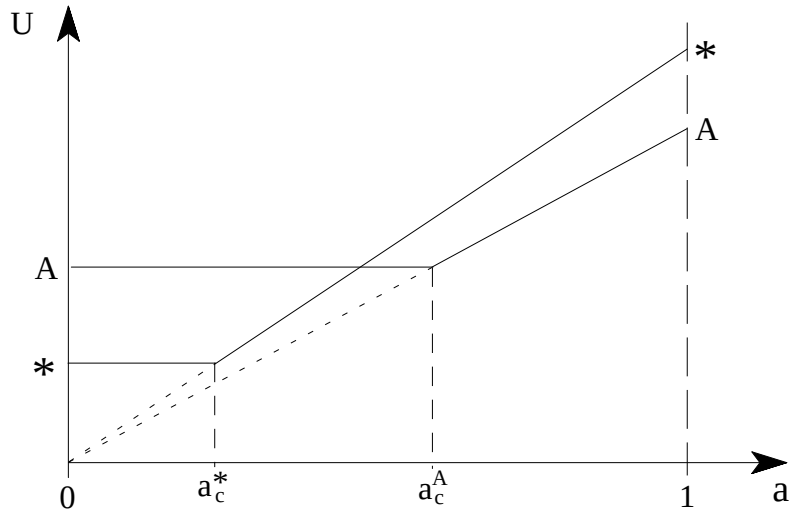

Figure 1: Distribution of intertemporal utility

In passing, let us point out that this new price vector will lead to a change in the production and consumption patterns. We already noted that production will shift toward the high-tech good. On the consumption side, agents will consume relatively more of the basic good and less of the high-tech good due to the relative price change. In any case, the small country assumption guarantees market clearing because it implies an infinitely elastic import supply and export demand, while the skilled wage w^* clears the labor markets.

We now address the distributional consequences that are our main concern. In view of our aim to investigate Pareto gains, we concentrate on utility instead of income. The indirect utility function (1), together with the equilibrium prices and wages derived above, gives us a clear picture of the distributional impact of the trade liberalization. In Figure 1, the AA schedule indicates the utility level

attained in autarky and the ** schedule shows the utility level under free trade for all agents $a \in [0, 1]$.

First note that the critical level of ability has changed due to liberalization. Since the skilled wage is higher under free trade and becoming skilled is therefore more profitable, we see that $a_c^* \ (= 1/w^*) \ < a_c^A \ (= 1/w^A)$. This leads us to distinguish three groups: those with $a > a_c^A$ who become skilled regardless of the regime, those with $a < a_c^*$ who do not become skilled in either regime, and finally the middle group who do not become skilled under autarky but find it beneficial to do so under free trade.

The high-ability group clearly gains from trade liberalization because its second-period real income increases. The low-ability agents, on the other hand, lose since their second-period real income falls. The group in the middle is of more interest because these agents change their decisions whether to become skilled. Under autarky, they decide not to become skilled, whereas under free trade they do. They give up income in the first period, invest in education, and then reap the higher real income of skilled workers in the second period. Within this group, the higher ability types attain a higher utility level than under autarky, whereas the lower ability agents, for whom becoming skilled is more costly, lose. Even these losers prefer to become skilled, however, because they would lose even more otherwise. Note that this change in decisions leads to additional dynamic gains from trade, which go beyond the well-known static gains, because the proportion of agents for whom the benefits of acquiring skills outweigh the costs increases.

Figure 2 shows the distributional effects of trade liberalization in the second period only. Again, free trade affects the three groups differently. As before, the high (low) ability group experiences a welfare increase (decrease) due to the

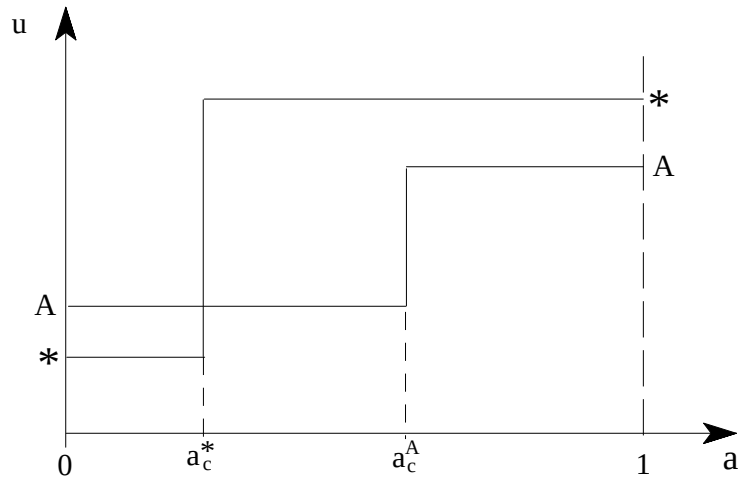

Figure 2: Distribution in the second period

respective change in second-period real income. This similarity of intertemporal and second-period distributional effects reflects the fact that neither group alters its behavior in period one. The picture looks dramatically different for the third (medium-ability) group whose members change their decisions in the first period. This group enjoys the most pronounced welfare increase in period two.

There are many intermediate regimes of more- or less-restricted trade whereas we have only considered the two extreme cases of autarky and free trade. For our small country, any move towards freer trade — in the sense of closing the gap between domestic and world market relative price — will have distributional implications similar to the extreme change of regimes discussed above.[15] For large countries, on the other hand, a change in the tariff rate could potentially lead to the Metzler paradox, with the tariff and domestic price moving in opposite directions.

[15]This only holds if the tariff revenue or the quota rent is distributed uniformly.

5 Redistribution after the Reform

The distributional analysis above shows that the gains from trade are distributed unevenly, taking the form of losses for some agents. This is the motivation and starting point for the literature on Pareto gains from trade. It analyzes in an essentially static framework[16] how different redistribution mechanisms can be used to achieve actual Pareto gains. In what follows, we will investigate how this analysis plays out in a truly dynamic context as exemplified by our model. Before doing so, we need to discuss the timing of the government's intervention, its objective, and the instruments at its disposal.

Regarding the timing within periods, we assume that the government always moves first, taking the position of a von Stackelberg leader.[17] As for the timing across periods, the crucial question is whether the government can commit before the reform (in period one) to a particular second period policy, or whether it enacts such a policy as it sees fit at the beginning of period two. Note that one particular second period policy is to remain inactive after the reform has been enacted, in which case redistribution would be carried out exclusively in period one. If the government could commit, then our model would reduce to a special case of the Arrow-Debreu general equilibrium model (in its intertemporal interpretation) and the traditional Pareto gains from trade result would apply.[18] Given serious doubts about politicians' ability to commit to a policy for the medium or long

[16]The Arrow-Debreu general equilibrium model admittedly has an intertemporal interpretation. It cannot, however, accommodate the reopening of markets and the inability of actors to commit.

[17]See Cordella and Ventura (1992) for counter examples to Pareto gains where this order is reversed in an otherwise static setting. Having the government move first seems more natural to us.

[18]The appendix demonstrates this result for the case that the government commits to refrain from redistribution in period two and limits its compensation scheme to period one.

term, we focus on the case where commitment is impossible. We thus consider redistribution in period two without prior commitment. Furthermore, we abstract from redistributive policy intervention in period one, as redistribution in the initial period would only complicate the analysis without offering additional insights.[19]

As for the government's objective, we follow the traditional, static literature in making use of the Pareto criterion. Admittedly, this approach is debatable. It assigns great importance to the status-quo — autarky in the context at hand — which could be justified on political economy grounds. In addition, it might appear as if this objective is not well defined given that the Pareto ordering is not necessarily complete. Yet, this vagueness can be regarded as generality. The criterion does not specify the optimal distribution beyond the requirement that no one loses. In terms of social welfare functions, it is compatible with a family of functions and we allow for any one of them.[20] In the end, we follow the literature we wish to extend and contend that the same effects will arise should the government be less ambitious in practice than to guarantee Pareto gains but still values equality. The timing question also arises in the context of the government's objective. We assume that when the government enacts redistribution in period two, its objective refers to second period welfare, thus ignoring what happened in the past, i.e. period one. Note that — in a richer dynamic context — this corresponds to pursuing the optimal policy path from the time of the decision onward.

Our last preliminary point regards the instruments the government can use to carry out redistribution. The static Pareto gains from trade literature considers lump-sum transfers, Diamond–Mirrlees style commodity taxation, and non-linear

[19] It is equivalent to considering only second period redistribution in a model with different endowments.

[20] Cf. Chipman and Moore (1972) for an example.

taxation in this chronological order.[21] Despite its practical relevance, progressive income taxation is no real contender since it is generally insufficient to achieve Pareto gains. If a winner and a loser both have the same income after liberalization, then the former cannot possibly compensate the latter by means of progressive income taxation.[22] In this paper, we concentrate on lump-sum transfers. The government is able to distinguish each agent by her ability level and levies a personalized tax (subsidy if negative) of $t_2(a)$ from her in period two. Notwithstanding the unrealistically demanding informational requirement and the resulting incentive incompatibility, we would like to demonstrate that strategic behavior can sabotage the gains from trade even when there is complete information and the government is equipped with the most powerful instrument. In practice, compensation will most likely be carried out by other means, but the intertemporal distortion we elucidate here would arise as well.

Now, recall the distributional effects of trade liberalization in the second period as discussed in the previous section (cf. Fig. 2). Pursuing its objective, the government will try to compensate the losers. To finance these payments, it will turn to those agents who gain from trade. But agents — perfectly informed of the government's objective — anticipate such an intervention. Those who would have been willing to invest in human capital in the absence of a compensation scheme could now act strategically. Instead of giving up part of their first-period endowment only to see the returns in the second period appropriated by the government, they could keep their endowment and count on the government to prevent them

[21] Grandmont and McFadden (1972), Kemp and Wan (1972), and Chipman and Moore (1972) use lump-sum transfers; Dixit and Norman (1980) apply Diamond–Mirrlees taxation; and Feenstra and Lewis (1991) as well as Feenstra and Lewis (1994), analyze non-linear taxation.

[22] See also Spector (2001).

from experiencing a loss of utility in period two. The government wants to avoid such decision reversals because they would involve transfer payments to agents from whom it could have otherwise raised revenue. In order to keep skill acquisition profitable, it has to lower the individual taxes it demands. It is this incentive constraint that can lower tax revenue to the point where it is no longer sufficient to compensate the losers, as the following proposition shows:

Proposition 1 *In general dynamic models, it may be impossible, after trade liberalization has been enacted, to achieve Pareto gains from trade by means of lump-sum redistribution.*

Proof: Consider our model with parameter values $\beta = 4/5$, $\alpha = 5/6$, and $b = 2$ as an example. The implied autarky wage is 2. Those agents who do not become skilled in autarky require a transfer of $t_2 = b^\beta - 1$ per person in order to attain their autarkic utility level under free trade if they decline to become skilled. If they are to change their decision and become skilled under free trade, the least they have to receive to avoid having their intertemporal utility with compensation $a\mathcal{B}(p^*)^{-\beta}(w^* + t)$ fall short of the autarky level $\mathcal{B}(p^A)^{-\beta}$ is $t_2 = b^\beta/a - b^{1/\alpha}w^*$. The critical ability level $\hat{a}_c = b^\beta/(b^\beta - 1 + b^{1/\alpha}w^A)$ minimizes compensation payments. The government will pay $b^\beta - 1$ to all $a \in [0, \hat{a}_c)$, a total of $(b^\beta - 1)\hat{a}_c \approx 0.24$, and pays the net amount of $b^\beta/a - b^{1/\alpha}w^*$ to all $a \in [\hat{a}_c, 1/w^A)$, a total of $b^\beta \ln(1/w^A) - b^{1/\alpha} - b^\beta \ln \hat{a}_c + b^{1/\alpha}w^A\hat{a}_c \approx -0.06$ for this group. For those agents who acquire skills in autarky, the smallest net amount they need to be paid is $t_2 = b^\beta w^A/a - w^*$ per person. Total net compensation payments for this group are $-b^{1/\alpha}(w^A - 1) - b^\beta w^A \ln(1/w^A) \approx 0.12$. Summing up, this redistribution scheme is seen to be infeasible because it would involve

crit. b		β								
		.1	.2	.3	.4	.5	.6	.7	.8	.9
	.1	1.001	1.002	1.003	1.004	1.005	1.006	1.007	1.008	1.009
	.2	1.004	1.008	1.012	1.015	1.019	1.023	1.027	1.031	1.035
	.3	1.009	1.017	1.026	1.035	1.044	1.053	1.062	1.072	1.082
	.4	1.016	1.031	1.046	1.063	1.079	1.097	1.116	1.138	1.162
α	.5	1.024	1.049	1.074	1.100	1.129	1.161	1.198	1.241	1.294
	.6	1.035	1.071	1.108	1.149	1.196	1.252	1.321	1.409	1.528
	.7	1.048	1.097	1.151	1.213	1.288	1.384	1.514	1.702	2.003
	.8	1.063	1.129	1.204	1.295	1.413	1.580	1.837	2.285	3.247
	.9	1.080	1.166	1.268	1.401	1.590	1.889	2.443	3.762	9.121

Table 1: critical values of b

paying out a positive amount. □

Our counter example — although it constitutes a valid proof — raises the question of robustness. The above result is indeed robust with respect to changes in the production technology (parameter α) and in preferences (parameter β).[23] The crucial variable is b which, loosely speaking, measures the scope for gains from trade. Intuitively, if b is high — i.e., if there are abundant gains from trade — then the incentive constraint will not prevent us from obtaining Pareto gains through lump-sum redistribution. Otherwise, if b is low, the constraint renders Pareto gains unachievable.

Table 1 gives critical values for b across the parameter space of α and β. At these critical values, the individual lump-sum transfers involved in keeping agents at their autarkic utility levels sum to zero — that is, the redistribution scheme

[23] We chose the specific values of α and β in the counter example solely because they conveniently result in an integer value for the autarky equilibrium wage.

produces neither a surplus nor a deficit. If the ratio of world market to autarky price is greater than the critical value for a given (α, β), the government runs a surplus — which it can then use to achieve a strict Pareto improvement.[24] If, on the other hand, the ratio is less than the critical value, then redistribution would require a deficit and Pareto gains are unachievable.

We see from Table 1 that the critical value of b is increasing in both parameters. Since an increase in α and β corresponds to a larger high-tech sector, this means that the strategic problem becomes more severe the more important the high-tech sector. The range of values in Table 1 translates into price changes in the order of one in a thousand to a factor of nine. Given that industries in industrialized countries grow ever more skill-intensive and that reforms enacted by the GATT and WTO make it likely that further trade liberalization will entail smaller price changes, the striking case established in our proposition seems to be more than a theoretical possibility.[25]

We would like to emphasize that even if b exceeds its critical value, the strategic effect will still be present, even though it does not dominate. Furthermore, should the government's objective be less ambitious than to guarantee Pareto gains or should it be unable to make use of lump sum transfers and use progressive income taxation instead, then the impossibility of gains from trade might not be an issue. Nevertheless, the negative strategic effect will still be at work and should be taken into account.

[24] For a detailed discussion of whether and how this is possible, see the exchange between Kemp and Wan (1986) and Dixit and Norman (1986), and also the less heated discussion in Hammond and Sempere (1995). Note that in the case of a small country with factor price equalization, redistributing the surplus does not change the price vector.

[25] This is an empirical question which awaits further investigation.

6 Remedial Policy

After establishing the negative result of the previous section, let us discuss one possible remedy. Suppose we supplement second-period transfers with ability-dependent first-period taxes (or subsidies) on human capital decisions. This would enable the government to steer agents toward the "right" investment decision. It simply imposes a tax whenever agents deviate from the decision they are supposed to take. These punitive taxes amount to investment directives because the government, armed with complete information, practically dictates the human capital decision. Thus able to avoid detrimental strategic investment behavior, it can then achieve Pareto gains from trade through lump-sum redistribution in the second period, as the following proposition shows:

Proposition 2 *There exist a set of ability-dependent, first-period taxes and subsidies on human capital acquisition* $t_1(a,s), t_1(a,u)$ *and a set of second-period, lump-sum transfers* $t_2(a)$ *that lead to a Pareto improvement over autarky.*

Proof: Let

$$t_1(a,u) = \begin{cases} 0 \\ -a \end{cases} \quad \text{and} \quad t_1(a,s) = \begin{cases} -a & \text{for} \quad a \leq 1/w^A \\ 0 & \text{for} \quad a > 1/w^A \end{cases}$$

On the equilibrium path agents then make the same human capital decisions as under autarky. Note that financing of this part of the scheme is feasible by construction. In the second period, let $t_2(a) = b^\beta - 1 \ \forall \ a \leq 1/w^A$ and $t_2(a) = (b^\beta - b^{1/\alpha})w^A \ \forall \ a > 1/w^A$. That is, the unskilled receive compensation, the skilled pay, and everyone attains the same second-period utility as under autarky.

The cost of this second part of the scheme across all agents amounts to

$$T_2 = (b^\beta - 1)/w^A + (b^\beta - b^{1/\alpha})(w^A - 1)$$

which — using the equilibrium autarky wage — can be rewritten as

$$T_2 = \frac{\beta}{w^A(1-\alpha\beta)}\left(\frac{b^\beta - 1}{\beta} - \frac{b^{1/\alpha} - 1}{1/\alpha}\right) < 0 \tag{7}$$

The inequality follows from the fact that $f(x) = (b^x - 1)/x$ is strictly increasing on $\Re_+$ and $1/\alpha > \beta > 0$. The scheme thus produces a budget surplus that can be used to achieve a strict Pareto improvement. □

The crucial assumption of the above proposition is that agents' ability levels are public knowledge. This assumption of complete information on part of the government seems extreme. It was justified when establishing the counter example of the previous section because there, granting the government complete information places the hurdle as high as possible. In the context of remedial policies and positive results, however, public knowledge of individual ability levels is clearly unrealistic. At best, the government could offer educational choices that elicit this information.[26]

7 Concluding Remarks

Is redistribution a help or a hindrance? That is the question posed in the title. Throughout the paper we have focused on exploring how and to what extent re-

[26] Exploring the design of such a revelation mechanism lies beyond the scope of this paper.

distribution can be a hindrance — an issue that only arises in the dynamic context. We show how the prospect of redistribution, intended to avoid the adverse effects of trade liberalization, can provoke strategic reactions on the part of the agents. Knowing that they will be compensated, or will have to pay compensation, leads them to underinvest prior to the reform. In extreme cases, this strategic underinvestment completely wipes out the gains from trade. Even if the negative effect does not dominate, it is still present and should be taken into account when discussing trade liberalization.

To answer the question posed at the outset, redistribution can be a hindrance as well as a help. From a theoretical standpoint, one needs to be cautious when extending the static Pareto gains from trade result — the theoretical underpinning of globalization — to a dynamic context. In practice, trade liberalization is always dynamic. We therefore feel that the above analysis bears great practical importance. How else could one explain the sad fact that young people take up careers and build up human capital in doomed sectors if not as the negative side effects of well meant but not completely thought out policies.

At a more fundamental level, similar problems arise whereever the government has an incentive to intervene in the future without being able to commit while private agents can influence future policy through their current actions. Hammond (1999) develops this idea using redistributive policy as an example. Leahy and Neary (1999) analyze the issue in the context of strategic trade policy. In their conclusion, they emphasize "the need for a fundamental rethink of economic policy in dynamic environments." This paper has provided such a rethink in the area of trade liberalization and redistribution. We believe that there are many other areas waiting to be revisited.

Appendix: Conventional Pareto Gains

In this appendix we verify that Pareto gains are possible in our model when the strategic effect is absent. To this end we assume that the government undertakes redistribution in the first period only and commits to refrain from any intervention thereafter. Whether such government behavior is credible and subgame perfect is questionable. But suppose that the government has found some commitment device so that agents rationally expect it to be inactive after the initial redistribution has taken place. The compensation scheme thus amounts to a simple redistribution of the first-period endowments before the agents make any decisions.

In what follows, we determine the lump-sum transfers which guarantee all agents their autarkic utility level. The sum of these transfers across all agents should be negative. In other words, the scheme should not require any positive transfer from the government. Only if this is the case will the scheme be feasible and can a potential budget surplus be used to attain strict Pareto gains.

With lump-sum transfers in the first period, the indirect utility function takes the form $V(p,w) = (1+t)\mathcal{B}p^{-\beta}$ for unskilled agents and $V(p,w) = (a+t)\mathcal{B}p^{-\beta}w$ for those who become skilled, where t is the net transfer payment the individual agent receives. This results in a critical ability level of $a_c^*(t) = (1-t(w^*-1))/w^*$ under free trade. The critical ability level under autarky is the same as before, $a_c^A = 1/w^A$, since no transfers are needed.

This leads us to distinguish three groups. For the low-ability agents who do not become skilled either under autarky or under free trade, equating $\mathcal{B}(p^A)^{-\beta} = (1+t)\mathcal{B}(p^*)^{-\beta}$ yields a required transfer of $t = b^\beta - 1$ per agent. The transfer leads to a modified critical ability level and the low-ability group now comprises all $a \in [0, (1-(b^\beta-1)(w^*-1))/w^*)$. The medium-ability group then

consists of all $a \in [(1-(b^{\beta}-1)(w^{*}-1))/w^{*}, 1/w^{A})$, and equating $\mathcal{B}(p^{A})^{-\beta} = (a+t)\mathcal{B}(p^{*})^{-\beta}w^{*}$ yields a transfer of $t = b^{\beta-1/\alpha}/w^{A} - a$ for each of them. Finally, the high-ability group is made up of all agents $a \in [1/w^{A}, 1]$, and equating $a\mathcal{B}(p^{A})^{-\beta}w^{A} = (a+t)\mathcal{B}(p^{*})^{-\beta}w^{*}$ yields a transfer of $t = a(b^{\beta-1/\alpha}-1)$ per capita. Summing over all the agents in each group gives

$$\begin{aligned} T_1 &= (b^{\beta}-1)(1-(b^{\beta}-1)(w^{*}-1))/w^{*} \\ T_2 &= \int_{(1-(b^{\beta}-1)(w^{*}-1))/w^{*}}^{1/w^{A}} (b^{\beta-1/\alpha}/w^{A} - a)da \\ T_3 &= \int_{1/w^{A}}^{1} a(b^{\beta-1/\alpha}-1)da \end{aligned}$$

which can be written as

$$T = \sum T_i = -0.5(b^{\beta-1/\alpha}-1) + 0.5(b^{\beta-1/\alpha}-1)/(w^{A})^{2}$$

$$-0.5((b^{\beta}-1) - b^{\beta-1/\alpha}/w^{A})^{2} + 0.5b^{\beta-1/\alpha}/(w^{A})^{2} - 0.5/(w^{A})^{2}$$

Since this sum is clearly negative, we see that the redistribution scheme is not only feasible but actually produces a positive surplus that can be distributed in order to make some or even all agents strictly better off. We see that Pareto gains from trade are possible in our model when the government uses redistributive policies only in the first period and credibly commits itself not to intervene thereafter. This result is not surprising since, in this special case, our model represents an Arrow–Debreu economy. We have simply shown the standard small-country Pareto gains from trade result in the context of our model. Note that the analysis above did not involve the actual value for the autarky skilled wage w^{A}. Thus the analysis also applies to moves from any initially restricted situation to free trade.

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