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Pareto gains from trade: a dynamic counterexample

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Abstract

In a two-period, general equilibrium model with a continuum of heterogeneous agents, we show that Pareto gains from trade can be impossible to achieve if the government uses lump sum redistribution after the trade liberalization and is unable to commit to a particular redistributive policy beforehand. The agents anticipate the intervention and, by underinvesting strategically, counteract the gains from trade.

Keywords: Gains from trade; Dynamic trade model; Time consistency

JEL classification: F1; D9

1. Introduction

The Pareto gains from trade result is an important theoretical justification for the notion that trade liberalization is beneficial. Trade will lead to aggregate gains and, although an unfortunate few might lose, the problem can, or could, be overcome by appropriate redistribution, or so the argument goes. The result has been established in a series of contributions,[1] albeit only in a static framework. Yet, the process of trade liberalization is inherently dynamic. Once we take account of this fact, the question of time consistency or subgame perfection arises.[2] Anticipating trade liberalization and expecting redistribution, agents might underinvest strategically.

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[1] 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, 1994), Hammond and Sempere (1995), and Facchini and Willmann (1999)—for a survey see Facchini and Willmann (2001).

[2] Kydland and Prescott (1977) provide examples of the time consistency problem. Staiger and Tabellini (1987) and Leahy and Neary (1999) analyze the time consistency of trade policy.

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In this note, we show how such strategic behavior can wipe out the gains from trade. Our analysis is set in a stylized, dynamic general equilibrium model that features a continuum of heterogeneous agents who differ in their abilities to acquire skills. We highlight the distributional consequences of trade liberalization by comparing the autarky solution of our model to a free trade regime without redistribution. Subsequently, we take the commitment to free trade as given and consider a government that uses lump sum redistribution to achieve Pareto gains after the reform but is unable to commit to a particular redistributive policy. Faced with such government, some agents find it optimal to underinvest strategically prior to the reform in order to influence their future compensation. Ex post, the government carries out the redistribution given the new circumstances, and it is indeed the private agents' anticipation of the government's reoptimization that leads them to behave strategically in the first place. To emphasize the robustness of our result, we present critical levels of aggregate gains from trade, below which the strategic effect dominates and Pareto gains are impossible.

2. Two-period model

Let there be a continuum of agents indexed by $a \in [0,1]$, where a denotes the agents' ability to acquire skills. Suppose that a is uniformly distributed on [0,1]. In period one, all agents are endowed with one unit of a perishable consumption good. They can either consume theirs in full or else decide to become skilled. The cost of acquiring skills 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 her entire endowment.

In period two, the agents are endowed with one unit of labor—skilled labor if they became skilled and unskilled labor otherwise—that they supply inelastically. Production takes place in two sectors: one sector produces the high-tech good according to the Cobb–Douglas production function $Y_h = L_s^{\alpha} L_u^{1-\alpha}$. The other sector uses only unskilled labor to produce the basic good. Its production function takes the form $Y_b = L_u$. The assumption of constant returns to scale implies that output prices must equal unit costs.[3] For the basic sector, this allows us to normalize both, the price of the basic good as well as the unskilled wage, to one. For the high-tech sector, cost minimization and the zero profit condition imply that

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

and where p denotes the price of the high-tech good, and w denotes the skilled wage.

On the consumption side, each agent derives utility from the consumption of the high-tech and the basic good 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

[3] Note that the demand side will imply that both sectors actually produce.

their second period utility. In other words, $U=au$ for those who become skilled and $U=u$ for those who do not. The corresponding indirect utility function takes the form:

$$V(p,w)=\begin{cases} Bp^{-\beta} & \text{if unskilled} \\ aBp^{-\beta}w & \text{if skilled} \end{cases} \quad \text{where} \quad B=\beta^{\beta}(1-\beta)^{1-\beta}. \tag{2}$$

Comparison of the indirect utilities for skilled and unskilled agents implies 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 remain unskilled.[4]

3. Distributional effects of trade

In order to elucidate the distributional effects of trade liberalization, we consider a move from autarky to free trade. Solving the model for the autarky case, we obtain the following equilibrium price vector:

$$w^{A}=\frac{1}{2}+\sqrt{\frac{1}{4}+\frac{\alpha\beta}{1-\alpha\beta}} \quad \text{and} \quad p^{A}=A^{-1}(w^{A})^{\alpha}, \tag{3}$$

where the superscript A stands for autarky. Notice that the skilled wage is greater than one, representing the skill premium over the unskilled wage.

We now turn to a scenario where the country embraces free trade after the initial period has passed. The standard small country assumption allows us to work with a given world market price which we take to be $p^{*}=bp^{A}$, where the star denotes free trade. Let $b>1$, this being the case of an industrialized country that, when it liberalizes trade, sees demand for the high-tech good increase and its price rise. Eq. (1) then yields the skilled wage under free trade:

$$w^{*}=(Ap^{*})^{1/\alpha}=(Abp^{A})^{1/\alpha}=b^{1/\alpha}w^{A}. \tag{4}$$

From the fact that $b^{1/\alpha}>b$, we see that the skilled wage increases more than proportionally, a manifestation of the Stolper–Samuelson effect. Given that the critical ability level is the inverse of the skilled wage, this increase also induces a new lower critical ability level:

$$a_c^{*}(=1/w^{*})<a_c^{A}(=1/w^{A}). \tag{5}$$

In other words, acquiring skills has become more profitable due to the higher skill premium.

Fig. 1 shows the distributional effects of the trade liberalization. In both diagrams, the AA schedule indicates the utility level attained in autarky and the ** schedule shows the utility level under free trade for all agents $a\in[0,1]$. While the left diagram depicts the intertemporal utility level, the right diagram shows the second period utility u. The induced change of the critical ability level 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

[4] The infinitesimal agent $a=a_c$ may decide either way.

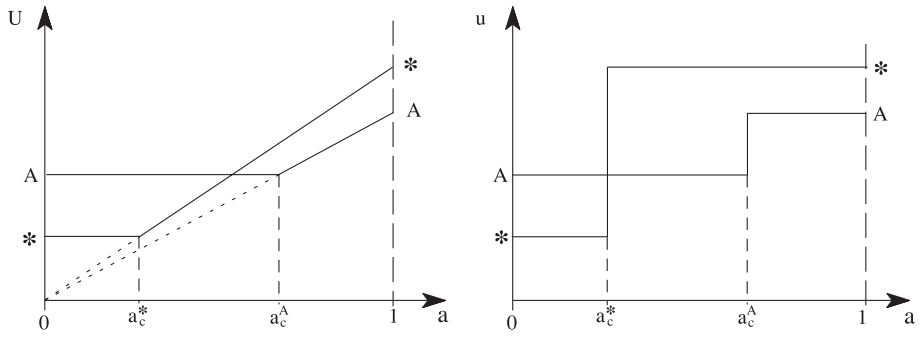

Fig. 1. Distributional effects of trade.

not become skilled in either regime, and those in the middle whose skill acquisition decision depends on whether the economy is liberalized or not.

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 because their real income in that period falls. The similarity of intertemporal and second-period distributional effects for these groups reflects the fact that neither group alters its behavior in period one. By contrast, agents of intermediate ability change their decisions. 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, in which they enjoy the most pronounced welfare increase.

4. Elusive Pareto gains

In a static framework, it is well known that Pareto gains from trade can be achieved through appropriate redistribution, in spite of the uneven distributional effects. As the counterexample below demonstrates, this result does not necessarily carry over to a dynamic setting.

In the dynamic context, there are several issues of timing that arise. As for the timing of the policy intervention, we focus on redistribution in period two because any such policy in the first period would simply correspond to an economy with different endowments. Regarding prior commitment, we sustain serious doubts about politicians' ability to commit, and thus abstract from this possibility.[5] Finally, with regard to the time frame of the government's objective, we assume that, when the government redistributes in period two, its objective in doing so refers to second-period welfare. In terms of a more explicit dynamic context, it pursues the optimal policy path from the time of the decision onward.

When it comes to the information and policy instrument available to the government, the more power it has at its disposal, the higher the hurdle for any counterexample. Our result below is therefore all the more surprising, as we endow the government with perfect information and access to the most powerful instrument: lump sum transfers. That is, we assume that the government knows each agent's ability level and can thus levy a personalized tax (subsidy if negative) of $t_2(a)$ from her in period two.

[5] Note that allowing for commitment would essentially take us back to a static world.

Table 1
Critical values of b

Critical b		β								
		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
α	0.1	1.001	1.002	1.003	1.004	1.005	1.006	1.007	1.008	1.009
	0.2	1.004	1.008	1.012	1.015	1.019	1.023	1.027	1.031	1.035
	0.3	1.009	1.017	1.026	1.035	1.044	1.053	1.062	1.072	1.082
	0.4	1.016	1.031	1.046	1.063	1.079	1.097	1.116	1.138	1.162
	0.5	1.024	1.049	1.074	1.100	1.129	1.161	1.198	1.241	1.294
	0.6	1.035	1.071	1.108	1.149	1.196	1.252	1.321	1.409	1.528
	0.7	1.048	1.097	1.151	1.213	1.288	1.384	1.514	1.702	2.003
	0.8	1.063	1.129	1.204	1.295	1.413	1.580	1.837	2.285	3.247
	0.9	1.080	1.166	1.268	1.401	1.590	1.889	2.443	3.762	9.121

Now, recall the distributional effects of trade liberalization in the second period. 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 the 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 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 reduce tax revenue to the point where it is no longer sufficient to compensate the losers, as the following example demonstrates:

Example 1. Consider our model with parameter values $\beta = 4/5$, $\alpha = 5/6$, and $b = 2$. 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 $aB(p^*)^{-\beta}(w^* + t)$ fall short of the autarky level $B(p^{\mathrm{A}})^{-\beta}$ is $t_2 = b^{\beta}/a - b^{1/\alpha}w^*$. The critical ability level, $\hat{a}_{\mathrm{c}} = b^{\beta}/(b^{\beta} - 1 + b^{1/\alpha}w^{\mathrm{A}})$, minimizes compensation payments. The government will pay $b^{\beta} - 1$ to all $a \in [0, \hat{a}_{\mathrm{c}})$ a total of $(b^{\beta} - 1)\hat{a}_{\mathrm{c}} \approx 0.24$ and pays the net amount of $b^{\beta}/a - b^{1/\alpha}w^*$ to all $a \in [\hat{a}_{\mathrm{c}}, 1/w^{\mathrm{A}})$, a total of $b^{\beta}\ln(1/w^{\mathrm{A}}) - b^{1/\alpha} - b^{\beta}\ln\hat{a}_{\mathrm{c}} + b^{1/\alpha}w^{\mathrm{A}}\hat{a}_c \approx -0.06$ for this group. For those agents who acquire skills in autarky, the smallest net amount they need to be paid is $t_2 = b^{\beta}w^{\mathrm{A}}/a - w^*$ per person. Total net compensation payments for this group are $-b^{1/\alpha}(w^{\mathrm{A}} - 1) - b^{\beta}w^{\mathrm{A}}\ln(1/w^{\mathrm{A}}) \approx 0.12$. Summing up, this redistribution scheme is seen to be infeasible because it would involve paying out a positive amount.

The result is robust with respect to changes in the production technology (parameter α) and in preferences (parameter β).[6] The crucial variable is b which, loosely speaking, measures the scope for

[6] In fact, we chose the specific values of α and β in the counterexample solely because they conveniently result in an integer value for the autarky equilibrium wage.

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 shows the 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 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. If, on the other hand, the ratio is less than the critical value, then redistribution would require a deficit and Pareto gains are impossible to achieve.

5. Concluding remarks

In this note, we have shown that strategic underinvestment can sabotage the gains from trade in a dynamic context. The counterexample presented might seem stylized; however, the strategic effect would persist (although perhaps not dominate) even if the government were less ambitious in its objective or used a different instrument.

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