Free Trade: What Are the Terms-of-Trade Effects?

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Abstract

Changes in trade policy affect a nation's economic welfare through terms-of-trade and volume-of-trade effects. A move to global free trade would imply higher world economic welfare equal to the sum of all nations' volume-of-trade, or efficiency, effects. Since the sum of the terms-of-trade effects across all nations is zero these effects are contentious. Konishi, Kowalczyk, and Sjöström (2003) have shown that if customs unions do not affect non-member countries, then immediate global free could be achieved if free trade were proposed together with international sidepayments equal to the terms of trade effects. How large would these terms of trade effects, and hence transfers, be? This paper presents some estimates from a simple computable general equilibrium model. In some cases transfers are not necessary for free trade, in other cases, terms-of-trade gains account for more than 50% of a country's gains from trade. (140 words)

1 Introduction

While the first multilateral trade negotiation round under the auspicies of the WTO, launched in 2001, has yet to be brought to a successful conslusion, countries have established – and continue to negotiate new – preferential trade agreements in the form of free trade areas or customs unions at an unprecedented rate.

Free trade areas and customs unions reduce trade barriers, but they also pose some potential problems: As first shown by Jacob Viner (1950), they may, surprisingly, reduce the economic welfare of the participants, and, indeed, of the world. They may also reduce the economic welfare of the non-member countries. And, finally, they may discourage further liberalization, and hence prevent global free trade, if they imply a situation where some member countries prefer to stay in a world of preferential trading areas because a move to free trade would imply losing valuable preferential access.

Until recently, the strongest theoretical result on free trade in a world of preferential trade was due to Michihiro Ohyama (1972) and Murray Kemp and Henry Wan (1976) who showed that if the members of a customs union are required to set their common external tariff such that trade with non-members remains constant, then there exists income transfers between mem-

bers such that no country loses. It follows that global free trade can be achieved through a sequence, or through parallel sequences, of continual expansions of such Ohyama-Kemp-Wan customs unions.

Hideo Konishi, Kowalczyk, and Tomas Sjöström (2003) have identified a more direct approach to global free trade which, moreover, takes into account the long-standing negotiating principle in GATT/WTO that for an agreement to be reached no group of members can object: maintaining the requirement that customs unions cause no change in trade with non-members, they show that a proposal for immediate global free trade combined with international income transfers that offset all terms-of-trade effects, would be blocked by no group of countries that would prefer the *status quo* or prefer to form an Ohyama-Kemp-Wan customs union. Free trade with international income transfers equal to the terms of trade effects is in the core of the customs union trade policy game.[1]

Under some circumstances, for example, if countries are of similar size, then it may be possible to get global free trade without transfers. However,

[1]This particular formula for transfers was first proposed by Earl Grinols (1981) as an explicit approach to the intra-union transfers that would yield the Ohyama-Kemp-Wan theorem. Kowalczyk and Sjöström (2000) show that these transfers support the formation of the world welfare-maximizing grand coalition in a world of international monopoly trade. Riezman (1985) found that free trade is generally not in the core of a world economy where countries can form customs unions. He does not allow, however, for international sidepayments.

if countries are of different size, then, as demonstrated in the two-country tariff game by Harry Johnson (1953-54), the larger country may obtain higher economic welfare from levying its optimal tariff rather than from free trade even if its trading partner retaliates. John Kennan and Riezman (1988) explore how differences in preferences or in endowments may induce such a breakdown of free trade in a two-country world, while Riezman (1985), Kennan and Riezman (1990), Eric Bond and Costas Syropoulos (1996), and Riezman (2000) explore how the ability of countries to form customs unions or free trade areas may affect the incentives of countries to agree to free trade. A common finding from these papers, which do not consider international sidepayments, is that it may be difficult to achieve free trade. Hence a mechanism of international sidepayments might be a useful, and perhaps even a necessary, additional tool for international trade liberalization.

How large might the transfers be that would support global free trade? This is the question we address in this paper. While the theoretical rationale for the possible need for sidepayments does not depend on the answer to this question – a country never pays more than it gains from free trade – the size of transfers could matter if the notion of international income transfers were to be brought from theory towards the world of practical trade policy: First,

some countries may find it difficult in practice to raise through taxation of domestic producers and consumers the revenue that would correspond to the terms of trade gains from free trade – presumably, it would be harder to raise a large than a small revenue. Secondly, while the notion of paying trading partners for market access is not entirely foreign in the context of negotiating free trade areas or customs unions – witness, for example, the history of the EU's regional and structural funds – international income transfers would be a somewhat novel tool for faciliting multilateral trade liberalization where negotiations have traditionally involved exchanges of market access. In theoretical work, transfers would tend to go from countries with relatively small domestic markets to countries with larger domestic markets. Transfers may even be regressive (although they need not be) by going from lower-income countries to higher-income countries. In any case, governments might find it difficult to obtain domestic political support for engaging in such payments.

We specify a three-country model of international trade in which key economic variables such as consumption, prices, and utility, can be calculated both before and after changes in trade policy. Assuming an initial situation where countries apply their non-cooperative Nash optimal tariffs, we

then calculate the change in each nation's real from global free trade. Decomposing this change into a terms-of-trade effect and an efficiency effect, and quantifying these effects, we then have magnitudes for the transfers discussed above to support global free trade from the terms of trade effects. We conduct these calculations for varying assumptions on country endowments, and find that transfers for free trade vary considerably depending on the economic environment: For very dissimilar countries with large initial trade, terms-of-trade gains from free trade may account for almost 60% of total gains. This implies, in turn, that if international sidepayments were introduced, such countries would see their gains from trade reduced by more than half. On the other hand, without such sidepayments, these countries might not experience these larger gains as free trade might not occur in the first place.

Section 2 states an expression for evaluating the change in national economic welfare from a change in trade policy in a competitive world economy. Section 3 introduces the role of international income transfers and terms-of-trade effects for obtaining global free trade implied by the main results of Konishi, Kowalczyk and Sjöström (op.cit.). Section 4 offers calculations of how large terms-of-trade effects from free trade might be in a three-country,

three-good general equilibrium model. Section 5 discusses and concludes.

2 National Economic Welfare in Perfect Competition

Consider a country i ($i = 1, ..., n$) where price-taking consumers and producers trade a finite number of goods with price-taking producers and consumers in other countries. Assuming that preferences can be expressed by the utility function of a representative consumer, that international trade is initially subject to tariffs the revenue of which is redistributed lump-sum to domestic households, and that trade is balanced, it is possible to express the change in a country i's national income, $\Delta\eta^i$, from a change in tariffs, whether own or trading partners', or a combination of own and partners', as:[2]

$$\Delta\eta^i = -\Delta(p^e)^i m_A^i + (p_B^i - (p_B^e)^i)\Delta m^i + S^i. \tag{1}$$

With subscript A denoting pre-change values and subscript B post-change

[2]See Ohyama (1972) or Earl Grinols and Kar-yiu Wong (1976) for a derivation of this expression. For small changes this expression becomes the terms-of-trade and volume-of-trade effects formalized by Ronald Jones (1969). Kowalczyk (2000) demonstrates that this is a better approach to analyzing the welfare effects of free trade areas or customs unions than is Viner's trade diversion and trade creation approach.

values, and Δ denoting a change, equation (1) states that the change in real income $\Delta\eta^i$, measured in units of some numèraire good, can be expressed as the sum of three terms: A terms-of-trade effect, $-\Delta(p^e)^i m_A^i$, where m_A^i is country i's pre-change trade vector and $\Delta(p^e)^i = (p_B^e)^i - (p_A^e)^i$ is the vector of changes in country i's tariff exlusive import-prices paid to foreign exporters and export-prices received by domestic exporters from foreign importers. A tariff-revenue effect, $(p_B^i - (p_B^e)^i)\Delta m^i$, where $\Delta m^i = m_B^i - m_A^i$, p_B^i is the vector of domestic, tariff-inclusive, prices in country i, and hence $p_B^i - (p_B^e)^i$ is the vector of post-change specific tariffs t_B^i, or the vector $\tau^i(p_B^e)^i$ where τ^i is a matrix of *ad valorem* tariffs. The final term, S^i, is the non-negative sum of production and consumption effects due to substitution by domestic producers and consumers as they face changed domestic prices. If y_A^i and y_B^i are profit-maximizing production pre- and post-change production, the production efficiency effect is $p_B^i(y_B^i - y_A^i) \geq 0$, and if c_A^i is initial consumption and if $c^i(p_B^i, u_A^i)$ would be consumption at the new domestic price vector p_B^i that preserves the initial level of utility u_A^i, then the consumption efficiency effect is $p_B^i(c_A^i - c^i(p_B^i, u_A^i) \geq 0$.

This approach allows for a theoretical comparison of a nation's real income from different policy strategies and, in particular, for a comparison of free

trade to customs unions or free trade areas.

3 Customs Unions and Free Trade

While GATT/WTO emphasizes non-discrimination between its members, GATT Article XXIV allows WTO members to form free trade areas, which eliminate the barriers on mutual trade between the free trade area members while leaving external tariffs on non-members to the individual free trade area member, or customs unions, which eliminate the barriers to mutual trade on the union members while setting common external tariffs on trade with non-members.[3]

As mentioned in the Introduction, Ohyama (op.cit.) and Kemp and Wan (op.cit) consider a variation of the Article XXIV customs union, namely a union where the common external tariffs be such that member trade with non-members not be affected, and they showed the existence of intra-union sidepayments such that no member country would be hurt from the formation of such a customs union.

Recognizing that GATT/WTO members in multilateral rounds negotiate

[3]Additional requirements are that internal barriers must be eliminated on "substantially all trade" and that the average rate of protection on trade with non-members must not increase.

under the long-standing principle that for an agreement to be established no group of members can object, Konishi, Kowalczyk and Sjöström (op. cit.) prove that if customs unions must satisfy that trade with non-members not be affected then there exist sidepayments such that a proposal for immediate free trade with such sidepayments will not be blocked by any nation or any Ohyma-Kemp-Wan customs union. In other words, the core of the customs-union game is non-empty since there is no group, i.e., customs union, such that every member prefers that customs union to global free trade with sidepaymnt. They show further, and more concretely, that a sidepayment formula that off-sets countries' terms-of-trade losses or gains through international lump-sum transfer payments together with global free trade, constitute an outcome in the core of the customs union game.[4] Thus they show that if T_B^i is the (aggregate) net transfer to country i by moving from the initial situation A to global free trade in B, then the sidepayment mechanism that transfers to country i the amount

$$T_B^i = (p_B^e - p_A^e)m_A^i \tag{2}$$

[4]These transfers follow from the proposal by Grinols (1981) to give each member of an Ohyama-Kemp-Wan customs union its initial trade vector. If the alternative under consideration is not a customs union but free trade, then Grinol's recommended transfers amount to off-setting countries' terms of trade effects.

supports global free trade as an outcome in the core.

How large would these transfers be? This is the question we consider next.

4 Computing the Terms-of-Trade Effects

We construct a general equilibrium model where three endowment economies trade three goods. Since we wish to derive how large transfers compensating for terms of trade effects would be, we calculate the terms of trade effects from global free trade assuming that transfers do not take place.

Countries set tariffs optimally and can choose to not be part of any trade agreement and charge the optimal tariff, or they could decide to join a coalition with other countries. They could be part of a free trade area (FTA), a customs union (CU), or they can all agree on establishing free trade (FT).

Each country is endowed with a fixed amount of each commodity where ω_j^i is country i's endowment of good j. We assume that the utility function of the representative consumer in country i is given by

$$U^i = \sum_{j=1}^{3} \beta_j^i \ln c_j^i$$

where U^i is the utility of country i, and β_j^i is the weight country i puts on consumption of good j, c_j^i. This preference formulation results in a linear expenditure system which allows us to employ numerical methods to solve the model. Further, with this structure we do not have to specify elasticities, and can state our results in terms of fundamental endowment parameters.

The net imports of each good, m_j^i, are $m_j^i = c_j^i - \omega_j^i$. Countries charge optimal tariffs on imports. Tariffs are asssumed to be *ad valorem* with τ_j^i denoting the rate charged by country i on imports of good j. If the world price for good j is p_j^e , then the domestic price of good j in country i is $p_j^i = (1+ \tau_j^i)\ p_j^e$.

Given that each country consists of identical individuals, aggregate demand is obtained from maximizing the utility subject to the budget constraint

$$\sum_{j=1}^{3}(1+\tau_j^i)p_j^e c_j^i = I^i = \sum_{j=1}^{3}(1+\tau_j^i)p_j^e\omega_j^i + \tau_j^i p_j^e m_j^i$$

where I^i is income of the representive consumer in country i which consists of income from the endowment $(1+\tau_j^i)p_j^e\omega_j^i$ plus any tariff revenue which is rebated to consumers lump-sum.

At world market prices, balanced trade implies that aggregate expendi-

ture in each country i must equal the value of country i's endowment in equilibrium. Thus

$$W^i = \sum_{j=1}^{3} p_j^e c_j^i = \sum_{j=1}^{3} p_j^e \omega_j^i$$

where W^i is the aggregate expenditure of country i. In addition to this constraint, the world demand for each good, should be equal to world supply:

$$\sum_{i=1}^{3} c_j^i = \sum_{i=1}^{3} \omega_j^i$$

This system of equations allows us to solve for p_j^e, c_j^i, and U^i.

Treating Nash equilibrium as the benchmark we are interested in seeing how large are the terms of trade effects – and, more precisely, how large are the terms of trade effects relative to the change in real income – from a move to free trade. With free trade, expression (1) simplies to:

$$\Delta\eta^i = -\Delta(p^e)^i m_A^i + S^i. \tag{3}$$

Consider figure 1 where we assume, for a moment, that only two goods, X and Y, are consumed:

Let E be the endowment point, C_1 the initial consumption bundle with

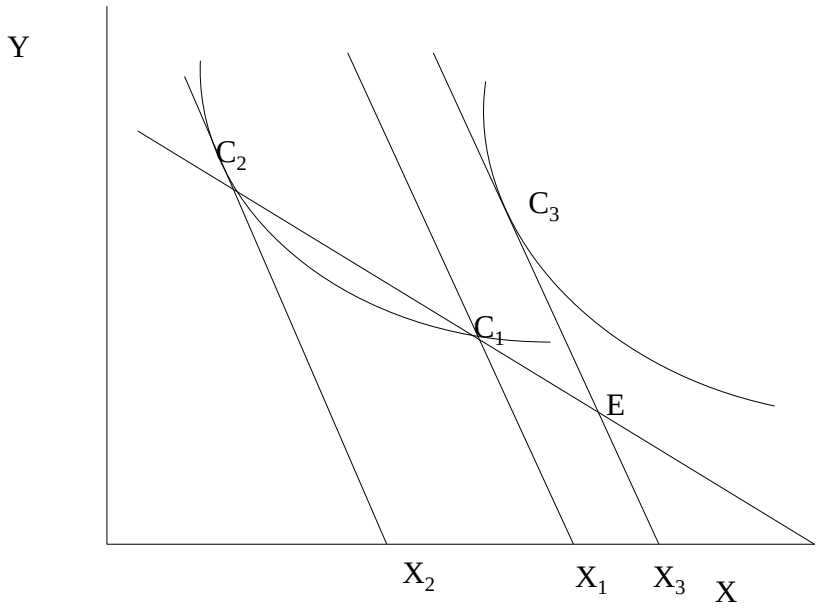

Figure 1: Nash equilibrium to Free Trade

Nash tariffs, and C_3 the free trade consumption bundle. The point C_2 is the consumption bundle that has equal utility with the Nash equilibrium consumption and would be chosen at free trade prices. As discussed in Section 1 of this paper we wrote C_2 as $c^i(p_B^i, u_A^i)$ when introducing the consumption effect from a price change. Evaluating changes at post-change prices, and assuming good X is the numèraire, we then have that the distance X_2X_3 represents the total increase in real income associated with a move from Nash equilibrium to free trade. We can decompose this change into the change due to the substitution effect, X_2X_1 and the change due to the terms of trade effect, X_1X_3. If we call the terms of trade effect dB and the substitution effect dC, then the total effect on real income of the move from the benchmark to free trade dA is

$$dA = dB + dC$$

We are particularly interested in seeing how much of this welfare change is explained by terms of trade changes. For that purpose, we consider four examples that differ in asumptions regarding country sizes and in how (dis-)similar countries are, and hence how much they trade.

5 Examples

5.1 Country 1 Is Large

Endowment matrix is given by:

	Good 1	Good 2	Good 3
Country 1	0.8	0.25	0.25
Country 2	0.1	0.5	0.25
Country 3	0.1	0.25	0.5

At free trade, consumption is:

	Good 1	Good 2	Good 3
Country 1	0.4333	0.4333	0.4333
Country 2	0.2833	0.2833	0.2833
Country 3	0.2833	0.2833	0.2833

Then, free trade utility is:

Country 1	116.38
Country 2	73.89
Country 3	73.89

with free trade prices:

Good 1	Good 2	Good 3
0.3333	0.3333	0.3333

In Nash equilibrium, we get the following optimal tariffs:

	Good 1	Good 2	Good 3
Country 1	0	1.2358	1.2358
Country 2	0.4453	0	0.3133
Country 3	0.4453	0.3133	0

Nash equilibrium consumption is:

	Good 1	Good 2	Good 3
Country 1	0.6226	0.3669	0.3669
Country 2	0.1887	0.3594	0.2737
Country 3	0.1887	0.2737	0.3594

and hence utility at Nash equilibrium is given by:

Country 1	117.36
Country 2	67.11
Country 3	67.11

Nash equilibrium prices are:

Good 1	Good 2	Good 3
0.3971	0.3014	0.3014

The changes in economic welfare and its components are:

	dA	dB	dC
Country 1	-0.004321461	-0.01883145	0.014509989
Country 2	0.0185298	0.00936573	0.00916407
Country 3	0.0185298	0.00936573	0.00916407

Hence:

	(dB/dA)	(dC/dA)
Country 1	435.77%	-335.77%
Country 2	50.54%	49.46%
Country 3	50.54%	49.46%

By moving to free trade the large country would forego the terms of trade gains from applying its optimal tariff, and it would require a substantial transfer to agree to free trade. The smaller countries experience terms of trade improvements that are about the same size as their consumption gains. If transfers were implemented, the smaller countries would surrender about half of their gains from free trade as payments to the large country.

5.2 Countries 2 and 3 Are Large

The endowment matrix is assumed to be:

	Good 1	Good 2	Good 3
Country 1	0.5	0.1	0.1
Country 2	0.25	0.8	0.1
Country 3	0.25	0.1	0.8

At free trade, consumption is:

	Good 1	Good 2	Good 3
Country 1	0.2333	0.2333	0.2333
Country 2	0.3833	0.3833	0.3833
Country 3	0.3833	0.3833	0.3833

Then, free trade utility is:

Country 1	54.47
Country 2	104.11
Country 3	104.11

with free trade prices:

Good 1	Good 2	Good 3
0.3333	0.3333	0.3333

Nash equilibrium optimal tariffs:

	Good 1	Good 2	Good 3
Country 1	0	0.4665	0.4665
Country 2	1.2857	0	1.474
Country 3	1.2857	1.474	0

Nash equilibrium consumption is:

	Good 1	Good 2	Good 3
Country 1	0.3222	0.168	0.168
Country 2	0.3389	0.5925	0.2395
Country 3	0.3389	0.2395	0.5925

and utility at Nash equilibrium is given by:

Country 1	43.33
Country 2	98.85
Country 3	98.85

with Nash equilibrium prices:

Good 1	Good 2	Good 3
0.2766	0.3616	0.3616

Estimates of changes in welfare and terms of trade and consumption effects are:

	dA	dB	dC
Country 1	0.024564678	0.01389861	0.010666068
Country 2	0.019624977	-0.0069993	0.026624277
Country 3	0.019624977	-0.0069993	0.026624277

implying:

	(dB/dA)	(dC/dA)
Country 1	56.58%	43.42%
Country 2	-35.67%	135.67%
Country 3	-35.67%	135.67%

In this example, two countries, 2 and 3, are relatively large due to a skewed world endowment that makes each country almost a monopoly seller of its export good. While both countries would experience terms of trade losses from global free trade as compared to the Nash equilibrium both countries would gain from free trade since their consumption effects are larger than their terms of trade losses. In this case, transfers would not be necessary for countries to agree to free trade. If, however, transfers equal to any terms of trade changes were implemented, country 1 would surrender about 57% of its gains from free trade. This transfer would be about the same relative magnitude as in example 1.

5.3 Countries 1,2 and 3 Are Different Size

The endowment matrix is given by:

	Good 1	Good 2	Good 3
Country 1	0.5	0.15	0.05
Country 2	0.25	0.7	0.05
Country 3	0.25	0.15	0.9

At free trade consumption is:

	Good 1	Good 2	Good 3
Country 1	0.2333	0.2333	0.2333
Country 2	0.3333	0.3333	0.3333
Country 3	0.4333	0.4333	0.4333

Free trade utility is:

Country 1	54.47
Country 2	90.14
Country 3	116.38

with free trade prices:

Good 1	Good 2	Good 3
0.3333	0.3333	0.3333

Nash non-cooperative tariffs are:

	Good 1	Good 2	Good 3
Country 1	0	0.4203	0.5044
Country 2	0.8142	0	1.012
Country 3	2.3359	2.5167	0

Nash equilibrium consumption is:

	Good 1	Good 2	Good 3
Country 1	0.3196	0.1984	0.122
Country 2	0.3043	0.4868	0.1575
Country 3	0.376	0.3146	0.7204

Countries' utility in Nash equilibrium are:

Country 1	37.96
Country 2	74.76
Country 3	117.92

Nash equilibrium prices are:

Good 1	Good 2	Good 3
0.258	0.2925	0.4493

Estimates for the terms in the welfare expression are:

	dA	dB	dC
Country 1	0.035476897	0.01996467	0.015512227
Country 2	0.047477242	0.01709829	0.030378952
Country 3	-0.006778772	-0.03702963	0.030250858

And:

	(dB/dA)	(dC/dA)
Country 1	56.28%	43.72%
Country 2	36.01%	63.99%
Country 3	546.26%	-446.26%

In this example, no two countries are of equal size. Global free trade hurts the largest country, country 3, and benefits the smaller ones, with the smallest, country 1, gaining most. The smallest country would surrender about 56% of its gains from free trade as a transfer, while the mid-sized country would surrender only about 36% of its gains from free trade.

5.4 Countries' Size More Similar

The endowment matrix is:

	Good 1	Good 2	Good 3
Country 1	0.5	0.2	0.2
Country 2	0.25	0.6	0.2
Country 3	0.25	0.2	0.6

At free trade, consumption is:

	Good 1	Good 2	Good 3
Country 1	0.3	0.3	0.3
Country 2	0.35	0.35	0.35
Country 3	0.35	0.35	0.35

Free trade utility is:

Country 1	54.47
Country 2	90.14
Country 3	116.38

and free trade prices are:

Good 1	Good 2	Good 3
0.3333	0.3333	0.3333

Nash equilibrium tariffs are:

	Good 1	Good 2	Good 3
Country 1	0	0.4203	0.5044
Country 2	0.8142	0	1.012
Country 3	2.3359	2.5167	0

Nash equilibrium consumption is:

	Good 1	Good 2	Good 3
Country 1	0.3196	0.1984	0.122
Country 2	0.3043	0.4868	0.1575
Country 3	0.376	0.3146	0.7204

and utility at Nash equilibrium is given by:

Country 1	37.96
Country 2	74.76
Country 3	117.92

Nash equilibrium prices are:

Good 1	Good 2	Good 3
0.258	0.2925	0.4493

Changes in real income, and terms of trade and consumption effects are:

	dA	dB	dC
Country 1	0.01776175	0.0019998	0.01576195
Country 2	0.005602365	-0.0009999	0.006602265
Country 3	0.005602365	-0.0009999	0.006602265

Hence:

	(dB/dA)	(dC/dA)
Country 1	11.26%	88.74%
Country 2	-17.85%	117.85%
Country 3	-17.85%	117.85%

In this, final, example, countries are made more symmetric, and terms-of-trade effects become relatively less important.[5] Every country gains from free trade and no sidepayments would be necessary for countries to agree to free trade. If, nevertheless, transfers were implemented, they would only be about 11% of the gains of the country whose terms-of-trade improve.

[5]In a completely symmetric world economy, there would be no terms-of-trade effects from moving from Nash tariffs to global free trade.

6 Discussion and Conclusion

We have presented estimates of terms-of-trade effects from moving from a non-cooperative tariff equilibrium to global free trade in a world trade model of perfect competition, and we have found that these terms of trade effects can be large. For countries whose terms of trade improve, they may constitute more than half of their total gains from free trade. For countries whose real income falls from free trade, the terms of trade effects are so large that they dominate the positive contribution from the consumption effects. This confirms that international income transfers that offset these terms-of-trade effects may be useful to garner support for global free trade.

The assumption of no substitution in production reduces the efficiency effects to be only the consumption effects, and would hence tend to raise the significance of the terms-of-trade effects relative to any change in real income. Additional substitution would also tend to imply that adjustments between equilibria are more in quantities than in prices, suggesting that more substitution would lead to smaller terms-of-trade effects. On the other hand, substitution in production might raise the initial trade volume in the non-cooperative Nash equilibrium, and thereby imply that terms-of-trade effects would be larger. So the effect from additional substitution may be

ambiguous.

Kowalczyk and Sjöström (1994) considered international sidepayments in a world where all international trade is in goods provided by monopoly firms. In that environment, the initial non-cooperative situation is one of monopoly mark-up prices, and the optimal situation or grand coalition is one where all goods are sold at marginal cost. Estimates of sidepayments in the world of monopoly trade are between 9% and 12% of gains from cooperation for countries that become net payers. This is small compared to the sidepayments in the present paper which, in one case, were shown to be almost 60% of what would otherwise be the transferor's gains from free trade.

We conclude that terms-of-trade effects may constitute a significant fraction of nations' gains or losses from trade, and hence may play a role for resistance to liberalization. Reducing their impact through may prove to be a productive approach to unlocking further gains from trade liberalization.

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