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Maoz, Yishay and Peled, Dan and Sarid, Assaf

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Yishay D. Maoz, Dan Peled and Assaf Sarid

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Abstract

The two-sector endogenous growth model of Rebelo (1991) and Felbermayr (2007) is embedded within an asymmetric two-country international trade and bargaining framework. Starting with a free trade equilibrium, the analysis reveals that: (i) foreign aid can increase the total world production of consumption goods due to specialization, raise therefore welfare in both countries and place both countries on a Balanced Growth Path (BGP); (ii) a trade agreement that is based on bargaining and endogenizes the linkage between foreign aid and adoption of trade policies generates higher welfare for both countries compared to autarky; (iii) with bargaining, the richer country's welfare increases while the poor country's welfare decreases compared to their welfare levels in case of free trade, despite the foreign aid transfer from the rich to the poor country.

Keywords: International trade, Aid, Balanced Growth

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Yishay D. Maoz: Department of Management and Economics, The Open University of Israel, 1 University Road, Raanana, 43107, Israel; e-mail: yishayma@openu.ac.il.

Dan Peled: Department of Economics, University of Haifa, Haifa, 31905, Israel; e-mail: dpeled@econ.haifa.ac.il.

Assaf Sarid: Department of Economics, University of Haifa, Haifa, 31905, Israel; e-mail: assaf_sarid@yahoo.com.

1. Introduction

In this article we analyze a theoretical model in which two countries bargain over a trade agreement. The agreement specifies the size of the foreign aid to be given by a rich country to a poorer one, and the terms of the trade that take place between the two countries after the aid is given. The aid in our analysis is given not because of any assumed generosity on the part of the rich country, but because it improves the capital allocation across the world and raises total world production. This world production surplus enables the rich country, through international trade, to raise its equilibrium consumption and welfare beyond their no-aid levels. To ensure it, and to push consumption and welfare as high as possible, the rich country uses a trade agreement to condition the aid on favorable terms of trade.

An important assumption in our model is that international loan markets are imperfect.[1] It is due to this assumption that aid can improve the capital allocation across the world and raise total world production. We also show how due to this increased world production it is possible that the rich country may benefit from giving the aid even if it is merely a gift in the sense that after the aid is given the trade between the two countries is perfectly free, rather than subject to the stipulations of an agreement.

It is possible though, depending on initial conditions and parameter values, that an aid given as a gift is not beneficial to the rich country. In that case the aid will be granted only if the subsequent international trade is not free but based on a trade agreement the terms of which favor the rich country.

[1] This assumption reflects both theoretical and empirical findings. Bulow and Rogoff (2005) justify theoretically why development banks give grants rather than loans to developing countries. Cohen, Jacquet and Reisen (2006) show that bilateral donors have favored grants over loans during the past three decades, and that in recent years, this preference has been emulated by multilateral aid agencies as well.

In fact, we show that even when giving the aid as a gift is beneficial to the rich country, (compared to a situation of free trade without the aid), it still may be even more beneficial for the rich country to enforce a trade agreement on the poor country. The reason for that is that in the negotiations over the agreement the rich country can use its superior bargaining power which springs from having greater welfare than the poorer country in case the negotiations fail.[2]

The model is based on the two-sector growth model of Rebelo (1991) and on its two-country international trade extension developed by Felbermayr (2007). This model has several realistic virtues. First, it generates the empirically observed decline over time in the relative prices of capital goods in terms of consumption.[3] Second, in the equilibrium of this model the developed country exports capital goods and the developing one exports consumption goods, as is typically the case in rich-poor countries trade relationships.[4]

We model these negotiations according to the Nash Bargaining mechanism analyzed in Nash (1950). This axiomatic mechanism alleviates the need to specify the procedure and structure of the negotiations. Consequently, it predicts an outcome which depends only on feasible allocations of the surplus to be created by the agreement and on the consequences of non-agreement. In that sense this Nash bargaining mechanism is better for our purposes than other bargaining mechanisms, for example – the non-cooperative ones of the type studied by Rubinstein (1982).

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[2] In the model, the superior bargaining power of the rich country springs merely from having greater welfare than the poorer country in case the negotiations fail. No ad-hoc assumptions, of the type sometimes used in the bargaining literature, were used for enhancing this bargaining power. See further discussion of this point in sub-section 5.2.

[3] See Cummins and Violante (2002) who calculate a decline of the relative price of capital goods in the United Stated at a rate of 3%-4% since 1974.

[4] See the evidence in Felbermayr (2007).

The results of this paper shed some light, then, on how developed countries manage to gain more than developing countries from establishing bilateral trade relationships, as seem to be indicated by World Trade Organization (WTO) empirical evidence. Computable general equilibrium of the outcomes of the Uruguay Round agreements show, for example, a disproportional GDP benefit to developed countries, compared to that enjoyed by developing ones (Ackerman, 2005). Furthermore, Stiglitz (2002) argues that through the Uruguay Round developed countries have set a lopsided division of profits generated by globalization in their own favor, either through maintaining agricultural subsidies given to farmers in the developed countries, or by legislating property rights that reflect solely the interests of firms in the developed world. Thus, understanding the economic forces behind such agreements can help interpreting their outcomes.

The rest of the paper is structured as follows. Section 2 offers a survey of the relevant literature on trade agreements and their outcomes. Section 3 sets up the basic growth and trade model. Section 4 describes the free trade scenario. Section 5 analyzes the bargaining-based trade agreement equilibrium, and section 6 concludes.

2. A survey of the literature

The economic relations between developing and developed countries are complex by nature. These relations are based mostly on two channels. The first is the transfer of resources as a loan or by foreign aid from the developed country to the developing one. The second is the cross-country trade between the two countries. These two channels are implicitly linked, as developed countries may tie the aid (or loan) to changing the terms of trade in their favor. This enhances the donor country's welfare at the expense of the developing country.

Foreign aid affects welfare either through promoting trade or growth, or by merely increasing income in the recipient country.[5] The linkage, however, between the three aspects - foreign aid, trade and growth - is somewhat vague in the literature.

Several studies explore the connection between aid and trade.[6] Among them, the theoretical ones typically assume that the trade policies of both countries and the size of the transfer are exogenous. They also assume, that when foreign aid is tied to some policy variables in the recipient country, the tying rule is exogenous, usually tying the aid to the poorer country's expenditure rather than to its trade policies. The few articles who abstract from such assumptions use static models, thus neglecting to consider the resulting growth implications of the relationship between foreign aid and trade. Moreover, these articles study tariff wars rather than trade agreements as a means of allocating surplus.[7] In contrast, in this article we study a two-country growth model where the aid is tied to the trade policies by an agreement between the two countries.

We focus on bilateral trade agreements signed between a developing country and a developed one, akin to the kind of regional bilateral trade agreements that were common during the 1990's.[8] Both parties to such agreements typically have to make concessions on different issues, including curtailing protectionist policies that were in

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[5] Sometimes foreign aid might cause a *decline* in welfare in the recipient country. This phenomenon is the well-known 'transfer paradox'. This paradox is not analyzed in the paper.

[6] For a full survey of the linkage of aid and trade see Suwa-Eisenmann and Verdier (2007).

[7] For a more detailed survey of this strand of the literature see the introduction in Lahiri, Raimondos-Moller, Wong and Woodland (2002).

[8] For instance, since the early 1990s the European Free Trade Association (EFTA) has established an extensive network of contractual free trade relations all over the world, including Singapore, Egypt, Israel, Chile, Mexico, Croatia, Colombia and Lebanon. For more details see http://www.efta.int/content/free-trade/fta-countries.

force prior the agreement. While such agreements have become more important and more widespread in recent years, there are still only few theoretical studies that attempted to study their general properties. Most of these studies concentrated on how bigger countries tend to win tariff wars, and typically employ static models, (e.g, Kennan and Riezman (1988)). The ones that do use dynamic models, like Devereux (1997), show that tariff wars reduce the world-wide growth rates compared to free trade, due to distortions inflicted by the tariffs. We examine in this paper what are the growth and welfare implications of tying foreign aid to costly trade policies even when such distortions are absent.

Among the properties of trade agreements are the trade policies that each country is to employ. It is worth noting that these policies need not affect trade directly by affecting the price of commodities (like tariffs and subsidies do). Instead, these policies can affect trade indirectly via their direct effect on production. Wade (2003) argues that the agreements that arose from the Uruguay Round - TRIPS, TRIMS and GATS on investment, trade in services and property rights respectively - benefit the block of the developed countries at the expense of the block of the developing countries, not by affecting the relative price of commodities, but by limiting the development tools available of the developing countries.

Multilateral trade agreements can often take resemblance to a bilateral agreement between developed and developing countries with conflicting interests (as suggested in the last paragraph). Most disputes preventing a new multilateral trade agreement among WTO members are between the block of developed countries led by European Union, US and Japan, and the block of developing countries led by India, Brazil, China and South

Africa. Clearly, the leading developed countries involved are those that also contribute most of the foreign aid. Theoretical studies assume that foreign aid is often motivated by economic considerations.[9] Hence, it can be argued that for obtaining a comprehensive understanding of foreign aid tied to trade agreements, trade negotiations should be considered along with the developed country's decision to provide foreign aid, as we do in the paper.

3. The Basic Model

Consider a world consisting of two economies, North and South, denoted N and S.[10] Each economy has a constant population. A representative agent in each economy seeks to maximize the following utility function:

$$U^i(t) = \int_0^\infty e^{-\rho t} \cdot \frac{c^i(t)^{1-\theta}}{1-\theta}\, dt, \tag{1}$$

where $c^i(t)$ is per-capita consumption at economy i at t, $i \in \{N, S\}$, ρ and θ are constants satisfying $0<\rho<1$ and $0<\theta<1$. The agent has one unit of labor which is supplied inelastically, owns the capital in the economy and continuously rents it to firms.

The lifetime budget constraint of the representative agent in each economy is given by

[9]While Alesina and Dollar (2000) argue that political rather than economic considerations underlie the aid given by developed countries in some cases, other studies, such as Asante (1985) claim that economic considerations typically motivate foreign aid.

[10] These economies may be either two countries or two blocks of countries, as in the case of WTO negotiations. Without any loss of generality, we do not distinguish here between the two options.

(2) $$\int_0^\infty c^i(t)e^{-r^i(t)t}dt = P_q^i(0)k^i(0) + \int_0^\infty w^i(t)e^{-r^i(t)t}dt$$

where $P_q^i(t)$ is the relative price of capital in terms of consumption goods in country *i* at time *t*. $r^i(t)$, $k^i(t)$ and $w^i(t)$ are, respectively, the interest rate, capital and wage in country *i* at time *t*.

Each economy has two competitive production sectors, one for consumption goods and the other for capital goods. Consumption goods (per capita) produced in country *i* at time *t*, denoted by $c_P^i(t)$, are given by:

(3) $$c_P^i(t) = B\left[k_C^i(t)\right]^\alpha,$$

where $0 < \alpha < 1$, $k_C^i(t)$ is the amount of capital employed in producing consumption goods in country *i* at time *t* and *B* is a technology productivity factor. The subscript *P* denotes production.

Capital goods are producible factors of production. The total amount of new capital goods in country *i* at time *t*, is denoted by $q^i(t)$. The country *i* at time *t* local production of these capital goods is denoted by $q_P^i(t)$ satisfying:

(4) $$q_P^i(t) = A\left[k^i(t) - k_C^i(t)\right],$$

where A is a technology productivity factor and $k^i(t)$ is the per-capita amount of capital in country i at time t. With capital depreciation rate δ, the capital stock in each country evolves through time according to:

$$(5) \qquad \dot{k}^i(t) = q^i(t) - \delta\, k^i(t)\,.$$

In a competitive equilibrium all markets clear at each point in time; firms maximize current profits, while the representative household rents labor and capital to firms, and chooses consumption so as to maximize the lifetime utility in (1).

Throughout the article the growth rates of capital, consumption and the relative price of capital in country i at time t shall be denoted by $g_k^i(t)$, $g_c^i(t)$ and $g_P^i(t)$, respectively.

The analysis is carried out under the following parametric assumption:

Assumption 1: $\alpha(1-\theta)(A-\delta) < \rho < A-\delta$.

As shall be shown below, the first inequality in *Assumption 1* suffices to satisfy the transversality condition ensuring that utility is bounded, and the second inequality is necessary for positive growth of consumption and capital.

3.1 Autarky Equilibrium

We start with the case of autarky, to be used as a benchmark for evaluating free trade and trade agreements outcomes later on. Under autarky consumption and investment are based on local production alone, implying $c^i(t) = c_p^i(t)$ and $q^i(t) = q_p^i(t)$. Since this case was already analyzed by Rebelo (1991), results are presented here without proof.

In Equilibrium, profits maximizing firms are indifferent at the margin between employing capital for producing consumption and capital goods. That is:

(6) $$P_q^i(t)A = \alpha B\left[k_C^i(t)\right]^{\alpha-1}.$$

Each economy experiences no transitional dynamics, and grows along a Balanced Growth Path (BGP) in which g_k, g_c and g_p are constants satisfying:

(7) $$g_k = \frac{A-\delta-\rho}{1-\alpha(1-\theta)}, \qquad g_C = \alpha g_k, \qquad g_p = -(1-\alpha)g_k.$$

By *Assumption 1* and (7), g_k and g_c are positive while g_p is negative, implying consumption and capital grow over time while the relative price of capital falls over time. Note that g_k, g_c and g_p are the same in both countries.

The interest rate is constant over time and is given by:

(8) $$r = A - \delta - g_P.$$

$k_c^i(t)/k^i(t)$, i.e., the share of capital allocated to producing consumption is constant over time and given by:

$$\gamma \equiv \frac{\rho - \alpha(1-\theta)(A-\delta)}{A[1-\alpha(1-\theta)]} \ .$$

The optimal growth rate is given by:

(9) $$g_C = \frac{1}{\theta}(r-\rho).$$

The consumption level path in each country is then given by:

(10) $$c_A^i(t) = B\left[\gamma k^i(t)\right]^{\alpha},$$

where the subscript A refers to autarky. The difference in initial amount of capital, therefore, manifests itself through the levels of consumption and capital and not via their growth rates

4. The Model with Free Trade

In this section we study the case where the two countries freely trade with one another. Specifically we add to the above specified model the assumption that at t=0 the two economies unexpectedly start trading with each other and that from that moment on both countries face the same relative price between the two goods. We also assume that international capital markets are imperfect and take this assumption to the extremity in which international lending and borrowing is impossible. Since this extension of the

Rebelo (1991) model was already done by Felbermayr (2007), the results in this section too are presented without proofs.

Without trade, the price of capital goods in the North is lower than in the South. Therefore, with trade the South imports capital goods, and exports consumption goods.

At all times the North is producing both capital and consumption goods and producers in the North are indifferent at the margin between producing capital and consumption goods, implying that equation (6) holds for the North. In contrast, if (and only if) initially the South is sufficiently poorer that the North, i.e., if $k^S(0)$ is sufficiently smaller than $k^N(0)$, then the South specializes in producing consumption goods and refrains from producing investment goods. This is the case we focus on from here on. In appendix A we show that this case takes place if and only if $k^S(0) \leq \frac{\gamma}{2-\gamma} k^N(0)$.[11]

The specialization starts at t=0 and from then on this two-country world experiences transitional dynamics towards a balanced growth path in which capital and consumption in each country grow at a constant rate. The specialization of the South in consumption goods persists throughout these dynamics. The specialization in the South implies that the world equilibrium relative price of capital goods satisfies:

(11) $$P_q(t) \leq \frac{\alpha B}{A}\left[k^S(t)\right]^{\alpha-1}.$$

[11] Note that $\frac{\gamma}{2-\gamma} < 1$ since $0<\gamma<1$.

(11) is an equality only along the BGP, a situation that the world economy, as said before, converges to.

Capital evolves in each economy according to (5). However, in the free trade scenario, while goods markets are integrated, international lending and borrowing are ruled out by assumption. This implies that the trade balance in each country equals zero at all times, i.e., that:

$$P_q(t)\left[q_P^i(t) - q^i(t)\right] = c_{FT}^i(t) - c_P^i(t), \tag{12}$$

where the *FT*-subscript represents free trade. In addition, the following clearing market condition must hold at all times:

$$c_{FT}^N(t) + c_{FT}^S(t) = B\left[k_C^N(t)\right]^\alpha + B\left[k^S(t)\right]^\alpha. \tag{13}$$

4.1. The balanced growth path

Along the Balance Growth Path (BGP) capital and consumption grow at constant rates in both countries. As Felbermayr (2007) shows, (7), (8) and (9) hold on the BGP for both countries. The resulting interest rates equality implies equal marginal products of capital, so that $k_C^N(t) = k^S(t)$. This in turn implies that, as in Autarky, the share of capital allocated to producing consumption goods in the North is the constant γ, since $k^S(t)$, $k^N(t)$ and $k_C^N(t)$ must all grow at the same rate.

The following Lemma establishes the *productive efficiency* of the BGP, a property that we use in analyzing foreign aid tied to trade policy in a cooperative trade agreement. The lemma looks at the different allocations to $k^S(0)$ and $k^N(0)$ of a given amount of an initial total world capital. As the lemma shows, the allocations that put the world on a BGP also maximize the world's total production of consumption goods at each point in time.

<u>*Lemma 1*</u>*: For each constant M>0, if* $k^S(0)$ and $k^N(0)$ *satisfy:*

(i) $k^S(0) + k^N(0) = M$

(ii) $k^S(0) = \dfrac{\gamma}{2-\gamma} k^N(0)$

then, for all t≥0, the world-wide consumption, $c^N(t) + c^S(t)$, *is higher than under any other pair of* $k^S(0)$ and $k^N(0)$ *that satisfy (i).*

<u>*Proof:*</u> Along the BGP $k^S(t) = k_C^N(t)$, ensuring equal marginal products of capital in producing consumptions across North and South at each point in time. This proves the claim given identical and concave production technologies. ■

5. The Bargaining-Trade Equilibrium

In the previous section it was shown that if initially South is sufficiently poorer than North then the world is on a dynamic path in which South specializes in producing consumption goods. In this section we show how the two countries can reach a Pareto superior outcome by tying foreign aid to trade.

More specifically, this case where initially South is sufficiently poorer than North is characterized by $k^S(0) < k_C^N(0)$ and therefore, due to diminishing marginal product of capital in producing consumption goods, foreign aid in the form of a capital transfer from the North to the South would increase world-wide consumption without reducing future world-wide capital stocks. In this section we first find the optimal size of the aid, and then employ the Nash-bargaining mechanism to show how the two countries divide the surplus of world production created by this transfer.

5.1 The optimal size of foreign aid

Let k_0^N and k_0^S denote the initial pre-transfer values of capital in North and South, and let T_k denote the size of the capital transfer. In Appendix A we show how the magnitude of T_k needed for locating the world on its BGP is: [12]

$$T_k = \gamma \frac{k_0^N + k_0^S}{2} - k_0^S . \tag{14}$$

[12] Note that if international borrowing and lending are allowed, equation (14) provides the size of the equilibrium loan taken by South, assuring equal returns to capital in both countries. The reasons for ruling out international B&L were discussed in a previous footnote.

Although this transfer maximizes equilibrium total world consumption at each point in time – it may not be optimal for the North to give it to the South. To see that, consider the case where the transfer is pure aid in the sense that after it is given to the South at t=0 the trade that develops is absolutely free. In that case, if k_0^S is sufficiently small then it is possible that the loss of capital due to the transfer would harm North more than the gains from trade would benefit it. We exemplify this possibility now for the extreme case in which k_0^S =0. In that case the case of free trade with no aid collides with the case of autarky and, based on (10), consumption in the North satisfy:

$$c_{FT}^N(0) = B\left[\gamma k_0^N(t)\right]^\alpha \tag{15}$$

In appendix A it is shown that if free trade takes place after the transfer T_k has been delivered, then consumption in both countries satisfy:

$$c_{FT}^N(0) = \gamma A P_q(0) k^N(0) + (1-\alpha) B\left[k_C^N(0)\right]^\alpha \tag{16}$$

and

$$c_{FT}^S(0) = \gamma A P_q(0) k^S(0) + (1-\alpha) B\left[k^S(0)\right]^\alpha , \tag{17}$$

where $k^N(0)$ and $k^S(0)$ are *post*-transfer initial capital stocks the two countries.

Applying (6), $k^S(0)=k_c^N(0)$, $k^S(0)=k_0^S+T_k$, $k^N(0)=k_0^N-T_k$ and (14) in (16), yields:

$$c_{FT}^N(0)=B\gamma^\alpha[\alpha(1-\gamma)+1]\left(\frac{k_0^N+k_0^S}{2}\right)^\alpha . \tag{18}$$

Thus, if k_0^S=0, consumption in the North, if it avoids aid, is above its consumption in the case it gives aid if:

$$2^\alpha-\alpha(1-\gamma)-1>0 \tag{19}$$

an inequality that holds when $\gamma>1-\ln(2)$.

By continuity, the result that under free trade consumption in the North may be better if it refrains from aid holds not just for k_0^S=0 but also for a range of strictly positive, yet sufficiently small, values of k_0^S. Note also that it was sufficient to exemplify it for consumption at t=0 since along the BGP consumption grows at a constant rate that is independent of k_0^S and k_0^N.

Thus, the capital transfer coupled with free-trade may or may not be Pareto improving. If it is, then North is better off even if the capital transfer is given as a gift, thus providing a simple, purely economic motivation for giving the aid. However, if the transfer is not Pareto improving, foreign aid and trade require that the North be compensated for the loss of capital by some kind of tying rule between aid and trade.

These compensating changes in trade policies can take many different forms, including tariffs, trade quotas, subsidies, or other policy tools affecting trade indirectly through their affect on production. We do not specifically model any of these policy concessions. Instead, we assume that these compensating trade arrangements can be represented by a welfare transfer from South to North. This allows us to use the bargaining mechanism as a solution concept for analyzing how can the North be compensated for the economic cost of giving foreign aid, without invoking non-economic (e.g. political) justifications. While the role of non-economic considerations is obvious and can be considerable, we want in this paper to examine how far purely economic considerations can go towards explaining observed ties between aid and trade policies.

5.2 The Bargaining Setup

Both countries have mutual interest in reaching an agreement, because foreign aid in the form of capital transfer creates a surplus of consumption without changing the growth rate. However, their interests are not identical, since each country desires a larger portion of the surplus.

For that purpose we employ the Nash (1950) axiomatic bargaining approach. There are four axioms the Nash bargaining solution must satisfy. Specifically, the solution must be invariant to affine transformation, Pareto efficient; symmetric and independent of irrelevant alternatives. Note, that our utility function is independent of affine transformations. It also satisfies the axiom of the independency of irrelevant alternatives. In order to satisfy the other two assumptions, we must assume the following assumptions, (see Chan (1988)):

Assumption 2 The two countries have full information about the preferences of their trading partners.

This assumption implies that the bargaining solution is Pareto efficient.

Assumption 3 Negotiators from each country have the same bargaining skill.

With this assumption and the fact that along the BGP the interest rates in both countries are equal, the bargaining solution should be symmetric in the sense that if the two countries are identical, their equilibrium payoffs are the same.

Following Nash (1950), since the bargaining problem satisfies these four axioms – it has a unique solution which is the solution to the following problem:

(20) $$\left(c^N, c^S\right) = \underset{c^N,\, c^S}{Arg\,Max}\left\{ \left[U^N\left(c^N\right) - \overline{U}^N\right]\cdot\left[U^S\left(c^S\right) - \overline{U}^S\right] \right\}$$

s.t.

(21) $$c^N + c^S = 2B\left(k^S\right)^{\alpha},$$

where c^i represents the consumption level in country i at time 0 resulting from the Nash bargaining mechanism and $\overline{U}^i$ is the utility obtained by the representative consumer of country i in case of *disagreement*. U^i is a function of the c^i i.e, the country i time 0 consumption alone, since the relevant equilibrium is along a BGP. k^S is the post-transfer capital in the South at t=0.

The disagreement point in the model is the autarky payoffs for several reasons. First, we rely on the Shapley version of the Nash solution, where the disagreement point reflects the credible destructive power of each player, and therefore we use the disagreement point as the minimal guaranteed payoffs to each country. Another reason for choosing this disagreement point is the endogenous tying rule of aid to trade policies. Consider the following scenario: The North and the South negotiate over agreeable trade policies and aid in the form of capital transfer from North to South. Both countries know that compared to autarky, agreement will improve their welfare. The North can *condition* the capital transfer on the bargaining outcome. If the bargaining process fails, the North will not give the capital transfer, and both countries will continue on their autarkic BGP. Therefore, the disagreement point is the utilities under autarkic scenario.

Alternative disagreement points, such as the free-trade allocation without transfer, are not credible. In such a scenario each country may impose tariffs unilaterally in an attempt to extract welfare from the other country. Kennan and Riezman (1988) showed how big countries win tariff wars. Hence, the free trade is not a credible disagreement point.

The disagreement points based on Johnson's Nash-Cournot tariff equilibrium, (see Mayer (1981) and Riezman (1982)), is a possible threat point. However, it may not be robust if other commercial policies (like quotas) are involved. Therefore, in order to generalize the solution to any commercial policies, we find the payoff in the autarky scenario more suitable. Since our analysis is valid either for bargaining over tariff rates or other trade policies (such as direct transfers from the South to the North in terms of consumption goods), the Nash-Cournot tariff equilibrium cannot be used as the disagreement point.

Notice also that, relative to South, North has greater bargaining power merely due to having a better disagreement point in case the negotiations fail, and that no ad-hoc assumptions magnifying this basic power are used.[13]

5.3 The Bargaining-Trade Outcome

Proposition 1 *Both countries are better off in equilibrium with trade and bargaining than in autarky, regardless of initial capital endowments.*

Proof: The total production of consumption goods after the capital transfer is made is higher than in autarky, as Lemma 1 shows. This implies that the pair of autarky values of South and North consumption is feasible, and therefore the Nash product is positive. The Nash product given by equation (20) is positive if both countries are either better or worse off with trade. Since the utility functions are strictly increasing, both countries are better off at the solution $\left(c^{N*}(0), c^{S*}(0)\right)$ than they are in autarky . ■

While proposition 1 provides a possible motivation for trade agreement if North conditions the aid on a suitable trade agreement, it does not shed any light on whether the

[13] The general form of the Nash Product is $\left[U^N\left(c^N\right)-\overline{U}^N\right]^{\beta}\cdot\left[U^S\left(c^S\right)-\overline{U}^S\right]$, where β represents bargaining power. Here we assume β=1 implying that the superior bargaining power of the North springs merely from $\overline{U}^N > \overline{U}^S$ and not also from β>1.

two countries prefer that trade agreement over free-trade. Proposition 2 resolves this issue.

Proposition 2: *For some initial capital endowments, North is better off (and the South is worse off) under bargaining over trade and aid than under free-trade.*

Proof: Maximizing the Nash product given by (20) implies the following first order condition:

$$(22) \qquad \left(c^N\right)^\theta \left[\left(c^N\right)^{1-\theta} - \left(c_A^N\right)^{1-\theta}\right] - \left(c^S\right)^\theta \left[\left(c^S\right)^{1-\theta} - \left(c_A^S\right)^{1-\theta}\right] = 0,$$

where c_N^i and c_A^i are consumption levels under agreement (if achieved) and autarky in country i at t=0, respectively.

Using the constraint $c^S + c^N = 2B\left(k^S\right)^\alpha$ it is possible to define the LHS of (22) as the function:

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$$(23) \qquad N\left(c^N, k_0^N, k_0^N\right)$$

$$\equiv \left(c^N\right)^\theta \left[\left(c^N\right)^{1-\theta} - \left(c_A^N\right)^{1-\theta}\right] - \left[2B\left(k^S\right)^\alpha - c^N\right]^\theta \left\{\left[2B\left(k^S\right)^\alpha - c^N\right]^{1-\theta} - \left(c_A^S\right)^{1-\theta}\right\}.$$

Note that k_0^N and k_0^S manifest themselves in this function through c_A^N, c_A^S by (10) and through k^S which along the BGP satisfies $k^S = \gamma \frac{k_0^N + k_0^S}{2}$. Thus, $N\left(c^N, k_0^N\ k_0^N\right)$ is strictly increasing in c^N. We now show that this function is negative when evaluated at the free trade allocation, implying that the argument that maximizes the Nash product is larger than the consumption level of the North under free trade.

The solution to the Nash maximization problem in (20) has the property that a player's outcome improves with his own disagreement outcome, and decreases with his opponent's disagreement outcome. Consequently, since the function $N(\bullet)$ is continuous, if the proposition holds when $T_k = 0$, then it is also true for some neighborhood of strictly positive capital transfers.

From equation (14) we know that when $T_k = 0$,

(24) $$k^N = \frac{2-\gamma}{\gamma} k^S$$

From (11), (16) and the result that along the BGP $k_C^N = k^S$ it follows that the consumption levels under free trade when $T_k = 0$ satisfy:

(25) $$c^N = B\left(k^S\right)^\alpha \left[1 + \alpha(1-\gamma)\right],$$

and

(26) $$c^S = B\left(k^S\right)^{\alpha}\left[1-\alpha(1-\gamma)\right].$$

Substituting (10), (24), (25), (26) and $x \equiv 1-\gamma$ into the function $N(\bullet)$ and simplifying yields:

(27) $$N\left(c^N\right) = B\left(k^S\right)^{\alpha}\left[2\alpha x-(1+\alpha x)^{\theta}(1+x)^{\alpha(1-\theta)}+(1-\alpha x)^{\theta}(1-x)^{\alpha(1-\theta)}\right].$$

The RHS of (27) is negative if and only if the term in square brackets is negative, which we prove in appendix B. ■

Proposition 2 shows that when $T_k = 0$, the bargaining outcome makes North better off, and South worse off compared to free trade without aid. We now show that North is better off and South is worse off compared to free trade with aid when $T_k > 0$.

<u>Proposition 3</u>: North is better off (and South is worse off) under bargaining over trade and aid than under free-trade with aid.

<u>Proof</u>: Equation (18) provides the consumption level in North in case it gives aid to South. Differentiating it according to k_0^S, we receive:

(28) $$\frac{\partial c_{FT}^N}{\partial k_0^S} = \frac{\gamma^{\alpha} B\left[1+\alpha(1-\gamma)\right]\alpha}{2}\left(\frac{k_0^N + k_0^S}{2}\right)^{\alpha-1} > 0.$$

Thus, for any given k_0^N, the smaller k_0^S, the lower c_{FT}^N. To show that the lower k_0^S, the higher c^{N*}, we show in appendix C that $\frac{\partial c^N}{\partial k_0^S} < 0$. Thus, the positive gap $c^{N*} - c_{FT}^N$ widens as k_0^S decreases, i.e., as T_k becomes strictly positive. ■

Propositions 2 and 3 imply that for some capital endowments if the North conditions the capital transfer in imposing trade policies that are in its favor, it may gain from it more than it could in free trade. In such cases, foreign aid to poor countries may improve their welfare, but first and foremost it benefits the richer countries. Since this is known to both countries, we can assume that the rich country prefers trade negotiations over free trade and predict that in such cases trade agreements are the preferred mechanism for regulating trade between North and South, as is often observed.

6. Concluding Remarks

In this paper we construct a dynamic growth model that combines international trade and foreign aid. We evaluate welfare in the donor and the recipient countries, and argue that foreign aid need not affect growth rates in either country. We also argue that the consumption levels do change due to the foreign aid. The foreign aid in the paper is tied to international trade policies.

The paper suggests that while free trade is best to the developing country, it may not be so for the developed one. As a result, by endogenizing the tie rule of the foreign aid to international trade policies through a bargaining mechanism, welfare is transferred from the developing country to the developed one, via trade agreements which are 'good' for the developed country. While these trade agreements make both countries better off compared to autarky; for some initial capital endowments these agreements also make the developed country better off compared to free-trade. This implies, of course, that while the developing country prefers free trade to a trade agreement, it would still be better off under the trade agreement than under autarky, and thus a trade agreement is still acceptable.

Although we do not model explicitly the trade policies over which countries bargain, we do show that there exist welfare transfers, reflecting direct resource transfers, subsidies or tariffs, which can then tie foreign aid to trade policies.

This result sheds some light over current negotiations between developed and developing countries, (in the context of the Doha Round), and the present stalemate in these talks. According to its proponents, the last round of negotiations aims to make trade fairer for the developing countries,[14] and it is frequently referred as "The Doha Developing Round". This round and its failure in Cancun, Mexico (2003), and later again in Geneva (2008) was partly attributed to the wide gaps between the developed and developing countries. Furthermore, most computable general equilibrium measures of the forecasted outcomes of the Doha Round show not only low gains on the aggregate, but also skewed outcomes towards developed countries (Ackerman, 2005). Since the round has not been terminated we cannot predict its ultimate conclusions. We can forecast in light of our analysis, that if an agreement is eventually obtained, it will favor the developed countries rather than the developing ones, despite declared goals to the contrary of these talks.

[14] For more details, see http://en.wikipedia.org/wiki/Doha_Round#cite_note-7.

Appendix A

The lifetime budget constraint of the representative agent in each economy is given by (2). Notice that since along the BGP $k_C^N(t) = k^S(t)$, wages in both countries are equal and given by $w(t) = (1-\alpha)B\left[k^S(t)\right]^{\alpha}$. It is straightforward that wages grow along the BGP at the same rate as consumption. Hence, the lifetime budget constraint in each country can be written as:

(A1) $$\int_0^{\infty} c_{FT}^i(0) \cdot e^{(\alpha g_k - r)t} dt = P_q(0) \cdot k^i(0) + \int_0^{\infty} (1-\alpha) B k^S(0) \cdot e^{(\alpha g_k - r)t} dt .$$

From (8), $\alpha g_k = \frac{r-\rho}{\theta}$, hence:

(A2) $$\int_0^{\infty} e^{(\alpha g_k - r)t} dt = \int_0^{\infty} e^{\left(\frac{\alpha(1-\theta)(A-\delta)-\rho}{1-\alpha(1-\theta)}\right)t} dt = \frac{\alpha(1-\theta)-1}{\alpha(1-\theta)(A-\delta)-\rho} .$$

Substituting (A2) into (A1) and calculating $c_{FT}^N(0)$ and $c_{FT}^S(0)$ yields (16) and (17).

At t=0 South gets a capital transfer from North. As a result, the relative price of capital satisfies the following condition:

(A3) $$P_q(0) = \frac{\alpha B\left[k_0^S(0) + T_k(0)\right]^{\alpha-1}}{A} .$$

Notice that $k^N(0) = k_0^N(0) - T_k(0)$ and $k^S(0) = k_0^S(0) + T_k(0)$. Substituting these expressions into (16) and (17) and the latter expressions with (A3) into the clearing market condition (13) implies (14).

Appendix B

In this appendix we complete the proof of *Proposition 2* by showing that:

(B1) $$F(x) \equiv 2\alpha x - (1+\alpha x)^{\theta}(1+x)^{\alpha(1-\theta)} + (1-\alpha x)^{\theta}(1-x)^{\alpha(1-\theta)} < 0,$$

for each set of values for (x, α, θ) in the relevant range. Recall that each of these parameters must be in the interval (0, 1). The proof is based on showing that $F(0)=0$, $F'(0)=0$ and $F''(x)<0$ for all 0<x<1.

$F(0)=0$ follows directly from (B1). Differentiating $F(x)$ and simplifying yields:

(B2) $$\frac{F'(x)}{\alpha} = 2 - \theta(1+\alpha x)^{\theta-1}(1+x)^{\alpha(1-\theta)} - (1-\theta)(1+\alpha x)^{\theta}(1+x)^{\alpha(1-\theta)-1}$$
$$- \theta(1-\alpha x)^{\theta-1}(1-x)^{\alpha(1-\theta)} - (1-\theta)(1-\alpha x)^{\theta}(1-x)^{\alpha(1-\theta)-1}.$$

$F'(0)=0$ follows directly from (B2). Differentiating the LHS of (B2) and simplifying yields, after tedious, yet straightforward, arithmetics:

(B3) $$\frac{F''(x)}{\alpha(1-\alpha)(1-\theta)} = \frac{\alpha\theta(1-\alpha)x^2 + (1+\alpha x)^2}{(1+\alpha x)^{2-\theta}(1+x)^{2-\alpha(1-\theta)}} - \frac{\alpha\theta(1-\alpha)x^2 + (1-\alpha x)^2}{(1-\alpha x)^{2-\theta}(1-x)^{2-\alpha(1-\theta)}},$$

$$< \frac{(1+\alpha x)^2}{(1+\alpha x)^{2-\theta}(1+x)^{2-\alpha(1-\theta)}} - \frac{(1-\alpha x)^2}{(1-\alpha x)^{2-\theta}(1-x)^{2-\alpha(1-\theta)}}$$

$$< \frac{(1+\alpha x)^2}{(1+\alpha x)^{2-\theta}(1+\alpha x)^{2-\alpha(1-\theta)}} - \frac{(1-\alpha x)^2}{(1-\alpha x)^{2-\theta}(1-\alpha x)^{2-\alpha(1-\theta)}}$$

$$= \frac{1}{(1+\alpha x)^{2-\alpha(1-\theta)-\theta}} - \frac{1}{(1-\alpha x)^{2-\alpha(1-\theta)-\theta}} < 0$$

where the three inequalities are based on α, θ and x being within the interval (0, 1). This establishes $F''(x) < 0$ which completes the proof

Appendix C

In this appendix we complete the proof of *Proposition 3* by showing that c^N, the consumption of the North at t=0 under a trade agreement, is a decreasing function of k_0^S.

Due to (22) and (23):

(C1) $$N\left(c^N, k_0^N, k_0^N\right) = 0,$$

which defines c^N as an implicit function of k_0^S and k_0^N. Simplifying (23) yields:

(C2) $$N\left(c^N, k_0^N, k_0^S\right) = 2c^N - \left(c^N\right)^{\theta}\left(c_A^N\right)^{1-\theta} - 2B\left(k^S\right)^{\alpha} + \left[2B\left(k^S\right)^{\alpha} - c^N\right]^{\theta}\left(c_A^S\right)^{1-\theta}$$

Differentiating (C2), bearing in mind the BGP property of $k^S = \frac{\gamma}{2}\left(k_0^N + k_0^S\right)$ and also that c_A^S is a function of k_0^S through (10), yields:

(C3) $$\frac{\partial N\left(c^N, k_0^N, k_0^S\right)}{\partial k_0^S} = -\alpha\gamma B\left(k^S\right)^{\alpha-1} + \theta\left[2B\left(k^S\right)^{\alpha} - c^N\right]^{\theta-1} B\alpha\left(k^S\right)^{\alpha-1}\gamma\left(c_A^S\right)^{1-\theta}$$

$$+\left[2B\left(k^S\right)^{\alpha} - c^N\right]^{\theta}(1-\theta)\left(c_A^S\right)^{1-\theta} B\alpha\left(k_0^S\right)^{\alpha-1}\gamma$$

Substituting $2B\left(k^S\right)^{\alpha} - c^N$ by c^S, which follows from (21), and noticing that $k^S > k_0^S$ because the South imports capital from North, leads to:

(C4) $$\frac{\partial N\left(c^N, k_0^N, k_0^S\right)}{\partial k_0^S} > \frac{\alpha\gamma B}{\left(k^S\right)^{1-\alpha}}\left[-1 + \theta\left(c^S\right)^{\theta-1}\left(c_A^S\right)^{1-\theta} + (1-\theta)\left(c^S\right)^{\theta}\left(c_A^S\right)^{1-\theta}\right]$$

$$> \frac{\alpha\gamma B}{k^S}\left[-1 + \theta\left(c^S\right)^{\theta-1}\left(c_A^S\right)^{1-\theta} + (1-\theta)\frac{c_A^S}{c^S}\left(c^S\right)^{\theta}\left(c_A^S\right)^{-\theta}\right] = 0$$

where the second inequality follows from the result that $c_A^S < c^S$ shown in *lemma 1.*

This leads to:

(C5) $$\frac{\partial c^N}{\partial k_0^S} = -\frac{\dfrac{\partial N}{\partial k_0^S}}{\dfrac{\partial N}{\partial c^N}} > 0,$$

which holds because the numerator is positive by (23) and the denominator is positive, as follows immediately from (23)

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