Country size, trade liberalization and transfers

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Abstract

In this paper, I develop a North-South pure exchange model to explain transfers between asymmetric countries. Two theories are investigated: firstly, I consider the theory of trade agreements; contrary to conventional wisdom, an efficient trade agreement (ETA) does not necessarily lead to free trade in the absence of internal political economy distortions. In fact, the ETA between asymmetric countries is such that the South sets a tariff higher than its Nash tariff and the North subsidizes its imports. When the difference in the endowment size is very large, the South's welfare gain is insufficient to compensate for the North's welfare loss. Interestingly enough, free trade always dominates the trade war equilibrium, regardless of countries' endowments. Secondly, I consider the theory of optimal tariffs and foreign aid. To encourage the South to liberalize trade, the North makes a transfer to the South - which increases with the countries' size asymmetry. To test this prediction, I use ACP-EU aid data and find that an increase in the recipient countries' relative size reduces foreign aid transfers. The present analysis provides a theoretical framework to understand the transition from the privileged market access to ACP-EU economic partnership agreements (EPAs) involving reciprocal trade concessions and the role of the adjustment transfers in this process.

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1 Introduction

Trade relationships between asymmetric countries often involve transfers. In the international trade literature, a transfer takes on various meanings. It means foreign aid when a donor gives financial or material resources to boost economic development and welfare in a recipient country, to help the poor or to promote its exports. In trade agreement models, a transfer represents the payment made by a country to its trading partner either because signing the agreement induces a loss for the partner, or because of a violation of the agreement, namely the application of a higher tariff. In this paper, I use a pure exchange model à la Kennan and Riezman (1988) to analyze different trade situations that involve these types of transfers and study how asymmetry in the endowment size affect the outcomes.

When studying transfers, one naturally considers foreign aid. In the very large aid literature, foreign aid serves various objectives, notably economic and political interests of donors. In fact, the transfer paradox literature introduced by Brecher and Bhagwati (1982) shows that a donor can be better and a recipient worse off as a result of foreign aid. Regarding the economic self-interest motive of giving, a donor country can tie its aid to the obligation by the recipient country to purchase goods that it produces.[1] Several empirical studies point to the fact that foreign aid promotes donor exports in the recipient countries (Nilsson, 1997; Martinez-Zarzoso, Nowak-Lehmann and Klasen, 2010; Nowak-Lehmann, Martinez-Zarzoso, Cardozo, Herzer and Klasen, 2009; Osei, Morrissey and Lloyd, 2004). However, the positive relationship between aid and donor exports not only reflects the practice of tying aid to donor imports, but also the "goodwill" or the recipient loyalty towards the donor exports (Arvin and Baum, 1977).

In trade agreement (TA) models, a transfer sometimes refers to the compensation payment intended to offset a loss resulting from a commercial arrangement. In fact, a free trade agreement (FTA) between countries of asymmetric size is usually known to be detrimental for a large country and beneficial to the small country. It follows from this that the small country has to make a side payment if the FTA is to be incentive compatible (Bond and Park, 2002; Park, 2000; Konishi, Kowalczyk and Sjostrom, 2003; Kowalczyk, 2006). This side payment is usually non-monetary in nature and consists of the adoption of regulations and values dear to the large country (democracy, environment protection, governance, sound investment code, protection of intellectual property rights (IPRs) to name a few; see Balleix, 2010; Bond and Park, 2002; Chauffour and Maur, 2011; Hoekman and Saggi, 2007; Limão, 2007). A major difference between the two types of transfers

[1] Aid conditionality takes on various forms: aid can be linked to democracy, human rights, governance performance of recipients, poverty reduction strategies (Rich, 2004), trade policy reform and specifically the reduction of tariffs in recipient countries (Lahiri, Raimondos-Møller, Wong and Woodland, 2002; Lahiri and Raimondos-Møller, 1997; Morrissey, 1993).

is not only their respective nature but also the direction of the payment: indeed, foreign aid is often given by the larger country to the small one, contrary to this compensation payment which is paid by the small country to the large one for access to its large market.

Finally, a transfer also means the financial compensation (fines or bonds) that a country infringing a trade agreement pays to its trading partner. Although possible only with the consent of the non-complying country, this compensatory measure is preferable to tariff retaliation. By retaliating the aggrieved country does "shoot itself in the foot" by impeding imports and thus harming its domestic consumers and/or importers (Bronckers and Van Den Broek, 2005). Limão and Saggi (2008, 2011) prove the existence of weakly renegotiation proof (WRP) fines and bonds that are equivalent to tariff retaliation in an infinitely repeated game.

In this paper, I develop a North-South pure exchange model to understand various types of transfers and the influence of countries' size on the amount and the pattern of transfer between commercial partners. The contribution of this paper to the international trade literature is fourfold. Firstly, I show that an efficient trade agreement (ETA) does not necessarily lead to free trade.[2] In the presence of asymmetry in endowment size, the ETA is such that the South sets a tariff higher than its Nash tariff and the North subsidizes its imports. Since the North is always worse off and the South better off, the ETA is unlikely to occur unless the North gets compensated for its loss. However, when the asymmetry in endowment size is high enough, the South's utility gain is not sufficient to compensate for the North's utility loss. Interestingly enough, free trade always dominates the trade war equilibrium, regardless of the countries' endowments. Secondly, on the self-enforcement of an FTA, I find that the WRP fines are higher for the South than for the North and increase with the size asymmetry for both countries. Moreover, the North's critical discount factor increases with the difference in endowment size while the South's respectively decreases. This result suggests that a large country has to be more patient than its small commercial partner before reaping the benefits of an FTA. The finding is in fact very intuitive: an FTA gives the small country (the South) immediate access to the large country's market (the North) in exchange for reforms which take time to be put in place and to produce results. Thirdly, I consider the theory of optimal tariffs and foreign aid. In a Nash bargaining game, foreign aid serves as an incentive to the South to liberalize trade; it turns out that the amount of the transfer increases with countries' size asymmetry. Finally, I test this prediction with EU-ACP aid data; I find that an increase in recipient countries' relative size — measured as the ratio of the recipient income to the donor income — reduces aid allocation considerably. The coefficient

[2] A trade agreement is efficient if it maximizes the sum of countries' welfares; Bagwell and Staiger (2001) show that free trade is efficient in the absence of a political economy parameter.

of this variable is much more higher than the recipient income often used in the aid literature.

The present work is related to three strands of the trade and transfer literature. The first one is the trade agreement literature. According to Bagwell and Staiger (1999, 2001), tariff negotiation between symmetric countries seeks a reciprocal liberalization which will increase trade volumes and welfare in both countries. On the contrary, Bond and Park (2002, BP) and Park (2000) show that a trade agreement is not mutually beneficial to asymmetric countries as the small country gains, while the large one looses. Mayer (1981) and Chongbunwatana (2004) find that a tariff negotiation between a small and a large country does not lead to a reciprocal liberalization but to a large number of equilibria such that the large country chooses a lower tariff and the small country grants import subsidies. In this article, I find the opposite result: the ETA between asymmetric countries is unique and entails an import subsidy by the large country (the North) and an higher import tariff by the small one (the South).[3] Contrary to Kennan and Riezman (1988) and Chongbunwatana (2004), free trade dominates the trade war equilibrium for all possible endowments.[4] Therefore, no transfer is made in free trade, which is efficient only in the case of symmetric countries.

This study is also related to a second strand which addresses optimal tariffs and foreign aid. Lahiri and Raimondos-Møller (1997, hereafter, LR) prove, in a three-country two-good trade model, that an international transfer tied to tariff changes in the recipient country can be welfare-improving for all three trading partners. In fact, the recipient benefits from the direct revenue effect of the transfer, while both the donor and the third country experience a terms-of-trade increase if they both are exporters of the recipient's import good. Using a two-country two good trade mode, Lahiri, Raimondos-Møller, Wong and Woodland (2002, hereafter, LRWW) conclude that it is optimal for a donor to make a transfer to a recipient if it induces the latter to liberalize trade.[5] In these models, the rationale of development aid is to compensate the recipient for the loss of tariff revenue due to trade liberalization. In most (least) developing countries, the informal economy amounts up to three quarters of the GDP (Gordon and Li, 2005) and governments heavily rely on them (Gallagher, 2008); tariff revenues are a very important source of income. In this article, I derive explicit solutions in terms of the model's parameters (countries' endowment), instead implicit solutions in terms of elasticities as in LR (1997) and

[3]These authors find multiple equilibria by using either a graphical analysis (Mayer) or Nash bargaining (Chongbunwatana); the unique solution found in this paper stems from maximizing the sum of both countries' utilities.

[4]I reach an opposite result owing to the fact that I use a Stone-Geary utility function, while the authors use the Cobb-Douglas one.

[5]To the best of my knowledge, LR (1997) and LRWW (2002) are the first to study the optimality of giving aid in trade models.

LRWW (2002). Following these authors, I consider various scenarios: neither in a simultaneous nor in a two-stage game it is optimal for the North to make a transfer to the South. However, foreign aid provides an incentive to the South to liberalize trade in a Nash bargaining game.

This analysis is also related to a third strand which deals with the determinants of aid allocation and trade. On the one hand, the aid literature shows that aid allocation is influenced by the recipient needs, measured by their GDP per capita (Feeny and McGillivray, 2008; Younas, 2008). On the other hand, the empirical trade literature shows that foreign aid and countries' income have a positive impact on trade. In my analysis, I introduce a new variable to measure the relative size of recipients. It is computed as the ratio of the GDP per capita the aid recipient to that of the donor. This variable is negatively associated with aid but positively with trade in both directions.

The present analysis provides a theoretical framework to understand the transition from the privileged market access to ACP-EU economic partnership agreements (EPAs) involving reciprocal trade concessions and the role of the adjustment transfers in this process. Since the ACP-EU Lomé conventions and despite being among the most protected markets, the ACP countries were granted trade preferences by the EU until the end of the Cotonou agreement in 2007.[6] This last treaty brought in the principle of reciprocity involving the ACPs giving more trade concessions to their European partners. By so doing, ACP-EU arrangements became more in line with WTO regulations. Given the importance of the EU for ACP trade, some countries are likely to lose important tariff revenue from cutting down tariffs on imports (Hinkle and Schiff, 2004; Fontagné, Laborde and Mitonitonne, 2011). To facilitate this transition towards a free trade which benefits both commercial partners[7], *"financial mechanisms are to be set in place to address specific EPA related adjustment costs"* (European Research Office, 2007).

Finally, this paper shows that a large country benefits stems from either non-trade issues linked to the agreement or direct trade gains. It is empirically observed that free trade is also economically beneficial to large countries, as it provides them with better access to raw materials, which *"are essential for the sustainable functioning of modern societies"* (European commission, 2008). In fact, the EU relies heavily on imports of "high-tech" metals for which Africa and South America, to name a few, are leading suppliers. Given the presence of competitors like China or India, the ACP-EU EPAs can be perceived as an instrument of the EU "raw

[6]This treaty signed in 1975 is actually an expansion of the 1963's first Yaoundé convention between the Europe and the French-speaking African countries to include the United Kingdom and English-speaking countries of the Pacific ocean and the Caribbean islands.

[7]Estimating the welfare effects of interim EPAs, Vollmer, Martínez-Zarzoso, Nowak-Lehmann and Klann (2009) find that only a small number of countries significantly benefit from the agreed liberalization agenda, while others experience a marginal welfare gain.

material diplomacy" whose aim is to secure access to raw materials by eliminating export restrictions (Ramdoo, 2011).

The remainder of this article is as follows. Section 2 presents the model and the theoretical results. Section 2.1 introduces the pure exchange model. Section 2.2 analyzes trade agreements and compensating transfers. Section 2.3 deals with the self-enforcement of trade agreements and financial transfers. Section 2.4 presents the optimal choice of transfer in three scenarios (simultaneous, two-stage game and Nash bargaining). Section 3 presents the empirical test of the model using ACP-EU foreign aid data. Finally, section 4 concludes.

Table 1. Different types of transfers in the international trade literature

Types of transfers	Findings	Studies
A. Foreign aid	The optimal transfer given by the donor is positive if it induces the recipient to liberalize trade.	Lahiri and al. (1997, 2002) **This paper**
	$Foreign\,aid = f\,(\underset{-}{GDP\,per\,cap\,recipients},\ \underset{+}{Imports\,recipients})$ $Foreign\,aid = f\,(\underset{-}{recipients'relative\,size\,(GDP)}, \underset{+}{imports}, \underset{+}{geo.\,avg\,tariff})$	Younas (2008), Feeny and McGillivray (2008) **This paper**
B. Side payment	An FTA between asymmetric countries is efficient and involves a compensation from the small country benefiting from the FTA to its large trading partner for market access.	Bond and Park (2002) Park (2000)
	An FTA between countries with asymmetric endowments is welfare-improving for both; therefore no compensation is needed. An efficient TA involves a utility transfer from the country with the small endowment to its large trading partner for its consumption utility increase.	**This paper**
C. Financial compensation	WRP fines are equivalent to tariff retaliation as a compensation mechanism in a trade agreement.	Limao and Saggi (2008, 2011)
	A small country pays higher WRP fines than the large one. These fines increase with the size asymmetry.	**This paper**

2 The Model

2.1 The Economic Environment

Consider a static pure exchange model in the spirit of Kennan and Riezman (1988) between which two countries, the North (without *) and the South (with *), trading two goods, x and y. The North gives an amount of foreign aid, T, to the South. Consumers in both countries have identical preferences represented by the Stone-Geary function[8]:

$$u(x,y) = \left(1 + x^{(*)E}\right)\left(1 + y^{(*)E}\right) \tag{1}$$

where $x^{(*)E}$ and $y^{(*)E}$ are each country's consumption of x and y.

The world endowment for each good is normalized to 1 and each country is initially endowed with both goods. The endowment structure is as follows: the North has $1-\gamma$ of units x and μ of y, while the South has γ units of x and $1-\mu$ of y. Since $0.5 < \gamma \leq \mu \leq 1$, the North (resp. the South) has a comparative advantage in y (resp. x) and that the South is either of equal size or a smaller country than the North .[9] The parameters γ and μ capture countries' relative size so that $\mid \mu - \gamma \mid$ measures the countries' asymmetry in endowment size.

Assume that both countries apply ad-valorem tariffs τ_x and τ_y^* respectively (for notational ease, I use $t = 1 + \tau_x$ and $s = 1 + \tau_y^*$ hereafter). Considering that the tariff proceeds and the international transfer payment is distributed to Southern consumers in a lump-sum fashion, the countries' budget constraints can be written as:

The North

$$tp_x(1-\gamma) + p_y\mu + (t-1)\,p_x Z_x = I \tag{2}$$

$$tp_x x^E + p_y y^E = I - T \tag{3}$$

The South

$$p_x\gamma + sp_y(1-\mu) + (s-1)\,p_y Z_y = I^* \tag{4}$$

[8] Contrary to Kennan and Riezman (1988) where consumer preferences have a Cobb-Douglas (CD) form, the present paper uses a Stone-Geary (SG) function, under which both countries are better off under free trade. Moreover, Nash tariffs exist when $\lambda = \mu = 1$, while they are undefined with CD utilities in KR.

[9] The assumption captures the fact that aid dependent countries are always poorer than the donors; I allow for both countries to be of the same size for comparison purposes.

$$p_x x^{*E} + s p_y y^{*E} = I^* + T \tag{5}$$

where I and I^* are the consumer incomes, which are given by their endowments of x and y valued at their domestic prices[10] and where Z_x, Z_y are imports of good x by the North and imports of good y by the South in the first period, respectively.

Equations (2) and (4) above respectively give the North's and the South's incomes as functions of their endowments ($\mathcal{IF}$). Owing to the transfer, the North (the South) consumes less (more) than it can afford with its revenue. This is shown by expenditure functions ($\mathcal{EF}$) (3) and (4). Both countries' trade expenditure functions ($\mathcal{TE}$) are as follows: $\mathcal{TE} = \mathcal{EF} - \mathcal{IF} = T$ for the North and $\mathcal{TE}^* = \mathcal{EF}^* - \mathcal{IF}^* = -T$ for the South.

This completes the presentation of the pure exchange model. Before turning to the trade analysis, I first determine equilibrium consumptions in both countries and quantities traded.

Equilibrium consumption and trade

The problem of the Northern representative consumer is to choose consumption bundle (x, y) to maximize its utility given by (1) subject to the budget constraint (3). The Lagrangian is formulated as follows:

$$L(x, y, \lambda) = u(x, y) + \lambda \mathcal{IF}(x, y) \tag{6}$$

Since x and y are the objects of choice, the first-order conditions (FOCs) of the Lagrangian are

$$\frac{\partial L(x, y, \lambda)}{\partial x} = 1 + y^E - \lambda t p_x = 0 \tag{7}$$

$$\frac{\partial L(x, y, \lambda)}{\partial y} = 1 + x^E - \lambda p_y = 0 \tag{8}$$

Rearranging both expressions and dividing (7) by (8) gives:

[10] Because of import tariffs, domestic prices of imported goods $\left(p_x =, p_y^*\right)$ are higher than the corresponding international prices $\left(p_x^* = p_x^w;\, p_y = p_y^w\right)$, so that $p_x = t p_x^*$ and $p_y = s p_y^*$.

$$\frac{1+y^E}{1+x^E} = \frac{tp_x}{p_y} \tag{9}$$

Likewise, consumer optimization in the South implies:

$$\frac{1+y^{*E}}{1+x^{*E}} = \frac{p_x}{sp_y} \tag{10}$$

Following KR (1988), I find the quantities traded in equilibrium. Let Z_i denote the volume of trade for good $i \in \{x, y\}$; if $Z_i < 0\,(Z_j > 0)$, then the country exports (imports) good $i\,(j)$. Assuming $\gamma > \frac{1}{2}$ and $\mu > \frac{1}{2}$ leads to the following trade pattern: the North (the South) imports good x (y) and exports good y (x). Therefore, I can write $x^E = 1 - \gamma + Z_x$, $y^E = \mu - Z_y$, $x^{*E} = \gamma - Z_x^*$ and $y^{*E} = 1 - \mu + Z_y^*$. Putting these expressions into (9) and (10) brings the following system of equations

$$\begin{cases} tp_x\left[1 + (1 - \gamma + Z_x)\right] = p_y\left[1 + (\mu - Z_y)\right] \\ p_x\left[1 + (\gamma - Z_x^*)\right] = sp_y\left[1 + \left(1 - \mu + Z_y^*\right)\right] \end{cases} \tag{11}$$

To solve the system (11), I first find the trade balance equation by subtracting (3) from (2) and (5) from (4):

$$\begin{aligned} p_x(\underbrace{1 - \gamma - x^E}_{Z_x<0}) + p_y(\underbrace{\mu - y^E}_{Z_y>0}) &= T \\ p_x(\underbrace{\gamma - x^{*E}}_{Z_x^*>0}) + p_y(\underbrace{1 - \mu - y^{*E}}_{Z_y^*<0}) &= -T \end{aligned} \tag{12}$$

Let x be the *numéraire* good so that $p_x = 1$; since trade is balanced, isolating p_y from each equation in (12) conveys the same result

$$p_y = \frac{Z_x + T}{Z_y} \tag{13}$$

Substituting the expression of p_y into (11) and assuming that trade is balanced ($Z_x = Z_x^*$ and $Z_y = Z_y^*$), the system of equations becomes

$$\begin{cases} tZ_y\left[1 + (1 - \gamma + Z_x)\right] = (Z_x + T)\left[1 + (\mu - Z_y)\right] \\ Z_y\left[1 + (\gamma - Z_x)\right] = s\,(Z_x + T)\left[1 + (1 - \mu + Z_y)\right] \end{cases} \tag{14}$$

The solution to the system of equations (14) is given by

$$Z_x^E = \frac{1 - 3sT - 4st - \gamma\left[st(\mu - 2) - \mu - 1\right] + \mu + 2st\mu}{1 + 3s + \mu + st\left(2 - \mu\right)} \tag{15}$$

$$Z_y^E = \frac{1 + \mu + 2st\left(\mu - 2\right) + T\left[1 - st(\mu - 2) + \mu\right] + \gamma\left[(1 - st(\mu - 2) + \mu)\right]}{1 + T + \gamma + 3t + st\left(2 - T - \gamma\right)} \tag{16}$$

In each country , equilibrium consumptions of x, y are respectively

for the North

$$\begin{cases} x^E = 1 - \gamma + Z_x^E = \frac{2(1+\mu)+3s(1-\gamma-T)+st(\mu-2)}{1+3s+\mu+st(2-\mu)} \\ \\ y^E = \mu - Z_y^E = \frac{3t\mu-1-\gamma-T+2st(2-\gamma-T)}{1+\gamma+T+3t+st(2-\gamma-T)} \end{cases}$$

for the South

$$\begin{cases} x^{*E} = \gamma - Z_x^E = \frac{3s(\gamma+T)-1-\mu+2st(2-\mu)}{1+3s+\mu-st(2-\mu)} \\ \\ y^{*E} = 1 - \mu + Z_y^E = \frac{2(1+\gamma+T)+3t(1-\mu)+st(\gamma+T-2)}{1+\gamma+T+3t+st(2-T-\gamma)} \end{cases}$$

Now that equilibrium consumption and trade are determined, different situations leading to transfers between countries can be studied. Let us start with a welfare analysis; section 2.1 compares countries' utilities under a trade war to their utility levels under an efficient trade agreement (ETA). Results show that, in the presence of size asymmetry, the South makes a utility transfer to the North for the ETA to be incentive compatible. Section 2.2 builds upon the optimal tariffs and transfers literature. Three scenarios are considered: a simultaneous game of foreign aid and tariffs, a two-stage game where aid is chosen in the first stage and tariffs in the second stage; and finally, a Nash-Bargaining negotiation over the amount of aid and the South's tariff, assuming that the North applies a unilateral free-trade policy. Section 2.3 deals with the self-enforcement of free trade, where transfers .

2.2 Trade war, efficient trade agreement and transfers

In this section, I do a welfare analysis, which compares the trade war equilibrium to the efficient trade agreement. In what follows, I model the trade war as a non-cooperative international tariff setting game, where $T = 0$. To determine trade war utilities, I first find countries' optimal tariffs; inserting $\left(\bar{x}^E, \bar{y}^E\right)$ into (1), the consumer optimization program in the North becomes

$$max\ \underset{t}{u}(x,y) = (1 + \underbrace{\frac{2(1+\mu) + 3s(1-\gamma) + st(\mu-2)}{1+3s+\mu+st(2-\mu)}}_{\bar{x}^E})(1 + \underbrace{\frac{3t\mu - 1 - \gamma + 2st(2-\gamma)}{1+\gamma+3t+st(2-\gamma)}}_{\bar{y}^E}) \tag{17}$$

The FOC of (17) w.r.t t is given by

$$\begin{gathered} 9\left[1+s(2-\gamma)+\mu\right]^2 \\ \left[1+3s\left(1-(2-\mu)t^2\right)+\gamma\left(1+3s+s^2t^2(2-\mu)+\mu\right)-2s^2t^2(2-\mu)+\mu\right]=0 \end{gathered} \tag{18}$$

Proceeding similarly with the South,

$$max\ \underset{s}{u^*}(x,y) = \left(1 + \frac{3s\gamma - 1 - \mu + 2st(2-\mu)}{1+3s+\mu-st(2-\mu)}\right)\left(1 + \frac{2(1+\gamma)+3t(1-\mu)+st(\gamma-2)}{1+\gamma+3t+st(2-\gamma)}\right) \tag{19}$$

The South's tariff reaction function is

$$\begin{gathered} 9\left[1+t(2-\mu)+\gamma\right]^2 \\ \left[1+3t\left(1-2s^2+\mu\right)+\gamma\left(1+s^2t\left(3+t(2-\mu)\right)+\mu\right)-2s^2t^2(2-\mu)+\mu\right]=0 \end{gathered} \tag{20}$$

The intersection of the two tariff reaction functions determines the Nash tariffs (denoted by t^N and s^N). Solving the system of equations (18) and (20) gives[11]:

$$s_1^N = \left(\frac{1+\mu}{2-\gamma}\right)^{\frac{1}{2}};\ t_1^N = \left(\frac{1+\gamma}{2-\mu}\right)^{\frac{1}{2}} \tag{21}$$

Nash welfares are obtained by inserting $\left(s_1^N, t_1^N\right)$ into $u(x,y)$ and $u^*(x,y)$; table 2 gives numerical values of Nash tariff and utilities for different values of γ, μ. In the presence of size asymmetry $\gamma < \mu$, the outcome is a higher Nash tariff and utility in the North than the South. This result is reminiscent of Limão and Saggi

[11] These tariffs look very much like KR (1988); the only difference is that I use a Stone-Geary utility function, for which Nash tariffs exists for a corner solution ($\gamma = \mu = 1$).

(2010) who find that uncoordinated small countries individually set a lower Nash tariff than their large trading partner.[12]

Let us move to the "efficient" trade agreement, which is such that countries' tariffs maximize the "world welfare", $W = u(x, y) + u^*(x, y)$ (Bagwell and Staiger 1999, 2002). Efficient tariffs are found at the intersection of countries' reaction functions ($\partial W/\partial s$ and $\partial W/\partial t$) and are respectively given by

$$s^E = \frac{2\mu - 1}{2\gamma - 1};\ t^E = \frac{2\gamma - 1}{2\mu - 1} \tag{22}$$

From (22), it can be easily seen that $s^E = t^E = 1$ if $\gamma = \mu$, that is, the efficient trade agreement leads to free trade only if the North and the South are symmetric. Then, both countries are better off under the ETA than trade war (table 2). Intuitively, the non-cooperative tariffs are inefficient since both countries can increase their trade volume and thus, their utilities by mutually cutting down their Nash tariffs.

In the case of asymmetry in endowment size ($\gamma < \mu$), the equilibrium is such that South imposes a tariff higher than its Nash tariff and the North subsidizes its imports. Table 2 describes countries' efficient tariffs and utilities for different values of γ, μ. Three observations are noteworthy. Firstly, both the North's import subsidy and the South's tariff increase with the asymmetry in endowment size. Secondly, countries' welfare levels are equal under efficient tariff and and remain at 2.250 for all combinations of (λ, μ). Lastly, the North is worse off under the ETA than the trade war equilibrium, while the South is better off. In other words, the trade war equilibrium dominates the ETA when $\gamma < \mu$ for the North; therefore, the latter will sign the ETA only if it receives a compensation payment from the South. Unfortunately, when the size asymmetry in endowment is too large, that is $\mid \gamma - \mu \mid \geq 3$, the South is unable to compensate the North, since its welfare gain is smaller than the latter's welfare loss. Formally, $u\left(s^E, t^E\right) - u\left(s^N, t^N\right) < \mid u^*\left(s^E, t^E\right) - u^*\left(s^N, t^N\right) \mid$ if $\mid \gamma - \mu \mid \geq 3$.

Simulation results presented in table 2 show that both countries gain from signing an FTA, even though it it is not globally optimal to do so. This result in very interesting as it brings new insight to the trade agreement literature. In fact, conventional wisdom often suggests that an FTA is always efficient and entails transfer when countries are asymmetric. Contrary to KR (1988), both countries are better off under an FTA than trade war. Therefore, there is no need for the

[12] Contrary to our model, they also find that small countries' tariffs tend to zero if their number is sufficiently high and their governments face no political pressures; this implies that free trade is the optimal policy for a small country lacking market power. This finding does not render account of high tariffs observed in developing countries. In the present framework, trade is positive under the following condition $\gamma > 0.5$ and $\mu > 0.5$.

South (the small country) to make a compensation payment to the North (the large country), as in Bond and Park (2002) and Park (2000). The table 2 shows that $u^N < u^{FT}$ and $u^{*N} < u^{*FT}$ for all $\gamma \leq \mu$.

All the above findings are summarized in the following proposition:

Proposition 1: *When the North and the South are symmetric, the ETA leads to free trade and both countries are better off (if* $\gamma = \mu$ *then* $s^E = t^E = 1$ $\Rightarrow u\left(s^E, t^E\right) > u\left(s^N, t^N\right)$ *and* $u^*\left(s^E, t^E\right) > u^*\left(s^N, t^N\right)$); otherwise, the ETA leads to an import subsidy *in the North and a higher tariff in the South so that the latter is better off and the North worse off than in a trade war situation (*if $\gamma < \mu$ then $s^E > s^N$ and $t^E < 1 \Rightarrow u\left(s^E, t^E\right) < u\left(s^N, t^N\right)$ and $u^*\left(s^E, t^E\right) > u^*\left(s^N, t^N\right)$*). To convince the North to sign the ETA, the South makes a compensation payment when* $\mid \gamma - \mu \mid < 3$*). For all values of* γ, μ*, both countries are better off under free trade than trade war.*

This concludes this section where I have shown that an ETA between asymmetric countries can involve a compensation payment when the North is worse off and the South better off. Before analyzing a different type of transfer, namely foreign aid, let's see how countries' size influences the enforcement of an FTA.

Table 2: Tariffs and welfares as functions of endowments

Endowments		Efficient trade agreement (ETA)				Nash welfare				Welfare under free trade	
γ	μ	s^E	t^E	$u\left(s^E,t^E\right)$	$u^*\left(s^E,t^E\right)$	t^N	s^N	u^N	u^{*N}	u^{FT}	u^{*FT}
0.6	0.6	1.0	1.0	2.250	2.250	1.07	1.07	2.247	2.247	2.250	2.250
0.6	0.7	2.0	0.50	2.250	2.250	1.11	1.10	2.398	2.096	2.403	2.103
0.6	0.8	3.0	0.33	2.250	2.250	1.15	1.13	2.553	1.947	2.560	1.960
0.6	0.9	4.0	0.25	2.250	2.250	1.21	1.16	2.714	1.801	2.723	1.823
0.6	1.0	5.0	0.20	2.250	2.250	1.26	1.20	2.881	1.656	2.890	1.690
0.7	0.7	1.0	1.00	2.250	2.250	1.14	1.14	2.240	2.240	2.250	2.250
0.7	0.8	1.5	0.67	2.250	2.250	1.19	1.18	2.389	2.085	2.403	2.103
0.7	0.9	2.0	0.50	2.250	2.250	1.24	1.21	2.544	1.931	2.560	1.960
0.7	1.0	2.5	0.40	2.250	2.250	1.30	1.24	2.705	1.779	2.723	1.823
0.8	0.8	1.0	1.00	2.250	2.250	1.22	1.22	2.227	2.227	2.250	2.250
0.8	0.9	1.33	0.75	2.250	2.250	1.28	1.26	2.375	2.067	2.403	2.103
0.8	1.0	1.67	0.60	2.250	2.250	1.34	1.29	2.531	1.908	2.560	1.960
0.9	0.9	1.0	1.00	2.250	2.250	1.31	1.31	2.209	2.209	2.250	2.250
0.9	1.0	1.25	0.80	2.250	2.250	1.38	1.35	2.357	2.042	2.403	2.103
1.0	1.0	1	1.00	2.250	2.250	1.41	1.41	2.184	2.184	2.250	2.250

2.3 Self-enforcing free trade agreement

As shown in section 2.2, free trade is not necessarily efficient, but at least every country is better off. It is therefore interesting to study the enforcement of an FTA for different levels of countries' endowments. In the absence of a supranational authority, a trade agreement needs to be self-enforcing; it has been shown that a repeated interaction helps overcome the prisoner's dilemma (Farrell and Maskin, 1989; Van Damme, 1989). The following analysis heavily draws on Limão and Saggi (2008, 2010) and Park (2002).

I consider an infinitely repeated game between the North and the South. Recall that in a trade war, countries' utilities are given by $\left(u^N \equiv u\left(s^N, t^N\right), u^{*N} \equiv u^*\left(s^N, t^N\right)\right)$, with $s^N = t^N$ if $\gamma = \mu$; under an FTA, they are given by $\left(u^{FT} \equiv u\left(1,1\right), u^{*FT} \equiv u^*\left(1,1\right)\right)$. If the North (resp. the South) deviates and applies its Nash tariff, $t^N\left(s^N\right)$, in a period, while its trading partner sticks to the agreement, its utility in that period is given by $u^D = u\left(1, t^N\right)\left[u^{*D} = u^*\left(s^N, 1\right)\right]$.

For simplicity, I consider that cheating induces an infinite tariff war.[13] Given this punishment scheme, Park (2002) shows that each country weighs the (discounted) utility from abiding by the agreement with the (discounted) payoff from cheating: $u^{FT} + \delta u^{FT} + \delta^2 u^{FT} + ... \lesseqgtr u^D + \delta u^N + \delta^2 u^N + ...$, where $\delta \in [0,1]$ is the country's discount factor. This is equivalent to $u^{FT}/\left(1+\delta\right) \lesseqgtr u^D + \delta u^N/\left(1+\delta\right)$. Re-arranging this expression brings a critical value of discount parameter, $\delta^C = \left(u^D - u^{FT}\right)/\left(u^D - u^N\right)$, so that for any $\delta > \delta^C$, there will be no cheating, since the country values the future gains from free trade highly enough.

In what follows, I compute δ^C for different values of the endowments γ, μ. Simulation results are presented in table 3. When countries are asymmetric, the North's (resp. the South's) critical discount factor is higher (resp. smaller) than the South's (resp. the North's). In other words, the North's (resp. the South's) critical discount factor increases (resp. decreases) with the difference in endowment size. This finding suggests that a large country has to be more patient than its small counterpart to reap the benefits of an FTA. The intuition behind this result is as follows: an FTA opens up the large country's market (the North) immediately to the small country (the South), while the North has to wait for the South to implement reforms it committed to. Obviously, reforms are a long process that takes time to produce results.

[13] Limão and Saggi (2008, 2010) do not consider a permanent Nash reversion, but a temporary punishment where the violating country cooperates by applying a free trade policy while its trading partner sets its tariff at its Nash level. However, they find that the lowest cooperative tariff that is weakly renegotiation proof is equal to the one under permanent trade war. This brings the critical discount factor, as I do in what follows.

Lemma 1: *In the presence of asymmetry* ($\mid \gamma - \mu \mid > 0$), *this inequality* $\delta^{*C} < \delta^{C}$ *always holds; thus, the agreement is self-enforcing if* $\delta^{*C} < \delta^{*} < \delta^{C} < \delta$. *Moreover, the North's (resp. the South's) critical discount factor* δ^{C} (δ^{*C}) *increases (decreases) with countries' asymmetry in endowment size*$\mid \gamma - \mu \mid$. If $\gamma = \mu$, then $\delta^{C} = \delta^{*C}$.

Tariff retaliation is not the only means to punish a deviating country to a trade agreement. Limão and Saggi (2008, 2011) show that monetary fines are an equivalent compensation mechanism.[14] This is actually the second type of transfer studied in this paper, when a country violates a trade agreement. In what follows, I focus on fines which have to be paid only in case of a violation of the FTA, contrary to bonds which have to be posted every period before trade takes place. Limão and Saggi (2011) prove that the maximum WRP fines correspond to the present discounted value of cooperation in the FTA. Formally, $f = \left[u\left(1,1\right) - u\left(s^{N}, t^{N}\right)\right] / \left(1-\delta\right)$ and $f^{*} = \left[u^{*}\left(1,1\right) - u^{*}\left(s^{N}, t^{N}\right)\right] / \left(1-\delta^{*}\right)$. Replacing δ and δ^{*} respectively by δ^{C} and δ^{*C}, I obtain the maximum fines f^{max} and f^{*max} for different values of γ, μ (table 3). For both countries, the amount of fines increases with the size asymmetry and the fine paid by the South is always higher than the North for all $\mid \gamma - \mu \mid > 0$. This result is very intuitive: the size asymmetry confers a greater market power to the North that entitles it to receive a greater compensation than the South. From lemma 1, it is known that it is more probable for the South than the North to sign the agreement; thus, when the South violates the FTA, paying large fines to the North ensures the continuation of the FTA. All the above is summarized in the proposition below:

Proposition 2: *Let* $f^{max} \equiv f\left(\delta = \delta^{C}\right)$ and $f^{*max} \equiv f^{*}\left(\delta^{*} = \delta^{*C}\right)$ *be the maximum WRP fines. When the North and the South are asymmetric* ($\mid \gamma - \mu \mid > 0$), $f^{max} < f^{*max}$. *If* $\gamma = \mu$, *then* $f^{max} = f^{*max}$. *For both countries, the amount of the fines increases with the asymmetry in endowments.*

[14] As noted by these authors, fines must voluntarily paid by the violator, while tariffs are imposed by the injured country.

Table 3: Welfare under defection and their critical discount parameter

Endowments		The North cheats				The South cheats			
γ	μ	u^D	u^{*D}	δ^C	f^{max}	u^D	u^{*D}	δ^{*C}	f^{*max}
0.6	0.6	2.253	2.246	0.56	0.006	2.246	2.253	0.56	0.006
0.6	0.7	2.410	2.092	0.61	0.0126	2.393	2.109	0.50	0.0128
0.6	0.8	2.575	1.941	0.68	0.022	2.543	1.970	0.45	0.023
0.6	0.9	2.749	1.793	0.75	0.035	2.697	1.837	0.41	0.036
0.6	1.0	2.932	1.645	0.83	0.050	2.855	1.709	0.36	0.053
0.7	0.7	2.263	2.232	0.56	0.023	2.232	2.263	0.56	0.023
0.7	0.8	2.424	2.074	0.61	0.035	2.376	2.121	0.50	0.036
0.7	0.9	2.595	1.918	0.68	0.051	2.522	1.984	0.45	0.052
0.7	1.0	2.774	1.763	0.75	0.069	2.673	1.852	0.41	0.073
0.8	0.8	2.279	2.210	0.56	0.052	2.210	2.279	0.56	0.052
0.8	0.9	2.446	2.046	0.61	0.070	2.349	2.138	0.50	0.071
0.8	1.0	2.622	1.884	0.68	0.092	2.492	2.003	0.45	0.095
0.9	0.9	2.302	2.178	0.55	0.093	2.178	2.302	0.55	0.093
0.9	1.0	2.475	2.008	0.61	0.118	2.314	2.163	0.50	0.120
1.0	1.0	2.332	2.136	0.55	0.149	2.136	2.332	0.55	0.149

2.4 The Optimal transfer and tariffs

2.4.1 Transfer and tariffs in a simultaneous game

As in section 2.2, each country sets a tariff to maximize its national welfare, taking its trading partner's tariff as given; moreover, the North chooses the amount of transfer to give to the South simultaneously. Contrary to the previous section, the transfer is not a compensation for a welfare loss due to a trade agreement but it is unilaterally given by the North under its foreign aid policy.

In this static game, the transfer (foreign aid) does not affect the choice of tariffs as it does in the two-stage game (section 2.4.2). The optimal aid is easily obtained by maximizing the North's utility function w.r.t T

$$max\underset{T}{u}(x,y) = \left(1+\frac{2\left(1+\mu\right)+3s\left(1-\gamma-T\right)+st\left(\mu-2\right)}{1+3s+\mu+st\left(2-\mu\right)}\right)\left(1+\frac{3t\mu-1-\gamma-T+2st\left(2-\gamma-T\right)}{1+\gamma+T+3t+st\left(2-\gamma-T\right)}\right) \tag{23}$$

The f.o.c equals

$$\begin{gathered} 9t\left[(T+\gamma-2)s-1-\mu\right] \\ \left[(T+\gamma-2)s^2t-\mu-s(4+T+\gamma+t\left(5-\mu\right)-1\right]=0 \end{gathered} \tag{24}$$

Equation (24) yields two solution candidates:

$$T_1=\frac{1+\mu+\left(2-\gamma\right)s}{s};\ T_2=\frac{1+\mu+\left(4+\gamma\right)s+\left(5-\mu\right)st+\left(2-\gamma\right)s^2t}{s\left(st-1\right)}$$

Knowing that the North's total endowment of both goods is $1-\gamma+\mu<1.5$, both T_1 and T_2 are rejected since they largely exceed the North's endowment. Indeed, susbtituting (21) in T_1 gives the following expression

$$T_1=\left(1+\mu\right)^{\frac{1}{2}}\left(2-\gamma\right)^{\frac{1}{2}}+\left(2-\gamma\right)>1.5$$

To see that $1-\gamma+\mu<1.5<T_2$, replace γ,μ by their possible values. Therefore, the optimal transfer equals zero. All the above is summarized in the following proposition:

Proposition 3: *In a North-South static game where tariffs and the transfer are chosen simultaneously, it is never optimal for the North to give aid to the South.*

The intuition behind this result is straightforward: by giving aid, the North transfers a part of its wealth, then its utility is lower. Moreover, the Nash tariff

against its exports in the South negatively affects its utility. Therefore, the Nash equilibrium is given by

$$\left(s^N, t^N, T\right) = \left(\left(\frac{1+\mu}{2-\gamma}\right)^{\frac{1}{2}}, \left(\frac{1+\gamma}{2-\mu}\right)^{\frac{1}{2}}, 0\right) \tag{25}$$

2.4.2 Transfer and tariffs in a two-stage game

Consider a two-stage game in which the North chooses a positive amount of foreign aid T in the first stage, and in the second stage, both commercial partners set their tariffs in a non-cooperative fashion, taking T as given. The f.o.c are respectively

$$\begin{gathered}\left[1+s\left(2-\gamma-T\right)+\mu\right]^2 \\ \left[1+3s\left(1-2t^2\right)-4s^2t^2+\left(\gamma+T\right)\left(1+3s+s^2t^2\left(2-\mu\right)+\mu\right)+st^2u\left(2s+3\right)+\mu\right]=0\end{gathered} \tag{26}$$

$$\begin{gathered}\left[1+t\left(2-\mu\right)+\gamma+T\right]^2 \\ \left[1+3t\left(1-2s^2\right)-4s^2t^2+\left(\gamma+T\right)\left(1+s^2t\left(3+t\left(2-\mu\right)\right)+\mu\right)-2s^2t^2\left(2-\mu\right)+\mu+t\mu\left(3+2s^2t\right)\right]=0\end{gathered} \tag{27}$$

The intersection of the tariff reaction functions determines the Nash tariffs (denoted by s_2^N and t_2^N). Solving the system of equations (26) and (27) gives[15]:

$$s_2^N = \left(\frac{1+\mu+T}{2-\gamma}\right)^{\frac{1}{2}};\ t_2^N = \left(\frac{1+\gamma}{2-\mu-T}\right)^{\frac{1}{2}} \tag{28}$$

From (28), it can be seen that the amount of the transfer decided in the first-stage influences the optimal tariffs in the second-stage. In fact, $\frac{\partial s_2^N}{\partial T} = \frac{1}{2(2-\gamma)}\left(\frac{1+\mu+T}{2-\gamma}\right)^{-\frac{1}{2}} > 0$ and $\frac{\partial t_2^N}{\partial T} = \frac{1+\gamma}{2(2-\mu-T)^2}\left(\frac{1+\gamma}{2-\mu-T}\right)^{-\frac{1}{2}} > 0$. This result is very intuitive: since the North makes a transfer to the South in the first-stage, then it will raise its tariff to offset the loss of utility caused by the transfer. Since the South anticipates the North's behavior, it will also raise its tariff in response to the North. Given that aid increases both tariffs and that countries' utilities decrease with their partner's tariff, it is not optimal for the North to give any aid in first place. As in the

[15]These tariffs look very much to KR (1988); the only difference is that I use a Stone-Geary utility function, for which Nash tariffs exists for a corner solution ($\gamma = \mu = 1$).

static case, the Nash equilibrium is given by (25). These results are summarized as follows:

Proposition 4: *In a North-South two-stage game where the transfer (foreign aid) is chosen in the first stage, the optimal transfer given by the North to the South is zero.*

2.4.3 The Nash-bargaining over the transfer and the South's tariff

In this section, I show that the North uses the allocation of the transfer to influence the South's trade policy. To do so, I consider a Nash negotiation between the North and the South over the amount of foreign aid and the South's tariff, assuming that the North already applies a free-trade trade policy. In other words, countries bargain over the sufficient transfer that the North must give the South to encourage a change in its foreign trade policy. The Nash social utility function can be written as

$$\underset{t,T}{max}\, U^{NS} \equiv \left[\left(1+x^{E}\right)\left(1+y^{E}\right)-u\left(1,s^{N}\right)\right]\left[\left(1+x^{*E}\right)\left(1+y^{*E}\right)-u^{*}\left(1,s^{N}\right)\right] \tag{29}$$

where $u\left(1,s^{N}\right)$ and $u^{*}\left(1,s^{N}\right)$ are respectively the North's and the South's threat points obtained by introducing $t=1$ and s^{N} into their utility functions.
FOCs are respectively given by

$$\frac{\partial U^{NS}}{\partial t}=\left[\frac{\partial x^{E}}{\partial t}\left(1+y^{E}\right)+\frac{\partial y^{E}}{\partial t}\left(1+x^{E}\right)\right]\left[\left(1+x^{*E}\right)\left(1+y^{*E}\right)-u^{*}\left(1,s^{N}\right)\right]$$

$$+\left[\frac{\partial x^{*E}}{\partial t}\left(1+y^{*E}\right)+\frac{\partial y^{*E}}{\partial t}\left(1+x^{*E}\right)\right]\left[\left(1+x^{E}\right)\left(1+y^{E}\right)-u\left(1,s^{N}\right)\right] \tag{30}$$

$$\frac{\partial U^{NS}}{\partial T}=\left[\frac{\partial x^{E}}{\partial T}\left(1+y^{E}\right)+\frac{\partial y^{E}}{\partial T}\left(1+x^{E}\right)\right]\left[\left(1+x^{*E}\right)\left(1+y^{*E}\right)-u^{*}\left(1,s^{N}\right)\right]$$

$$+\left[\frac{\partial x^{*E}}{\partial T}\left(1+y^{*E}\right)+\frac{\partial y^{*E}}{\partial T}\left(1+x^{*E}\right)\right]\left[\left(1+x^{E}\right)\left(1+y^{E}\right)-u\left(1,s^{N}\right)\right] \tag{31}$$

Solving the system of equations (30) and (31) gives the North's equilibrium tariff and foreign aid amount. Since working with values t^N and s^N proves analytically difficult, I solve the system numerically for different possible values of γ and μ. Results are shown in table 4 below. As found in the previous section, both tariffs increase with endowments. In addition, the South's trade war tariff (Nash tariff) is higher than the North's for all $\gamma < \mu$. However, the latter's welfare under the trade war is higher than the South's. Comparing the trade war equilibrium to free trade, it turns out that both countries are always better off under free trade than under Nash tariffs, regardless of their sizes (endowments); actually, welfares by the amount. This finding is at odds with KR (1988), who find that a larger country is better off under a tariff war than free trade with its smaller trading partner.[16]

The two last columns of table 4 gives the North's tariff and the amount of aid that the North is willing to give to the South to keep its welfare at its Nash level, assuming that the South agrees to free trade policy.

Proposition 5: *Starting from a situation where the North applies a free-trade policy* ($t_0 = 1$) *and the South, its optimal tariff* $\left(s = s^N\right)$*, the Nash-bargaining solution is such that the optimal transfer (aid) is positive and the South adopts a free trade policy. Moreover, the amount of the transfer increases with countries' asymmetry in endowment size.*

[16] These opposite results owe to the difference in countries' utility functions (Cobb-Douglas in KR, 1988 vs. Stone-Geary in the present paper).

Table 4: Tariffs and welfares as functions of endowments

Endowments		Nash bargaining					
		Threat points		Nash-bargaining solution (NBS)			
γ	μ	$u\left(s^N,1\right)$	$u^*\left(s^N,1\right)$	s^{NBS}	T	u^{NBS}	u^{*NBS}
0.6	0.6	2.246	2.253	1.0	0.002	2.247	2.254
0.6	0.7	2.393	2.109	1.0	0.005	2.394	2.110
0.6	0.8	2.543	1.970	1.0	0.009	2.546	1.972
0.6	0.9	2.697	1.837	1.0	0.013	2.701	1.840
0.6	1.0	2.855	1.709	1.0	0.018	2.860	1.713
0.7	0.7	2.232	2.263	1.0	0.010	2.235	2.266
0.7	0.8	2.376	2.121	1.0	0.015	2.379	2.124
0.7	0.9	2.522	1.984	1.0	0.020	2.527	1.989
0.7	1.0	2.673	1.852	1.0	0.026	2.680	1.858
0.8	0.8	2.210	2.279	1.0	0.023	2.216	2.285
0.8	0.9	2.349	2.138	1.0	0.030	2.357	2.146
0.8	1.0	2.492	2.003	1.0	0.037	2.502	2.012
0.9	0.9	2.178	2.302	1.0	0.041	2.188	2.313
0.9	1.0	2.314	2.163	1.0	0.050	2.326	2.175
1.0	1.0	2.136	2.332	1.0	0.066	2.153	2.349

3 Empirical analysis

3.1 Methodology and data

In this remainder of this study, I investigate the empirical validity of *proposition 3* presented in the previous section. For this purpose, I use ACP-EU data on foreign aid, trade and tariffs. To test the theoretical predictions developed above, I first write an equation of the determinants of foreign aid based on equation (16). Isolating T yields

$$T = \frac{\left[1+\gamma+3t+(2-\gamma)\,st\right]Z_y^E + \left[4+\gamma\mu-2\left(\gamma+\mu\right)\right]st - \left(1+\gamma+\mu+\gamma\mu\right)}{1+\mu-Z_y^E+\left(2-u-Z_y^E\right)st} \tag{32}$$

Comparative statics analysis on (32) shows that the North's aid allocation to the South unambiguously increases with its exports and its tariff, but decreases with endowments and the South's tariff. Formally, $\frac{\partial T}{\partial Z_y^E} > 0$, $\frac{\partial T}{\partial \gamma} < 0$, $\frac{\partial T}{\partial \mu} < 0$, $\frac{\partial T}{\partial s} < 0$, $\frac{\partial T}{\partial t} > 0$ and $\frac{\partial T}{\partial (st)} > 0$ (appendix); aid (T) increases with donor exports $\left(Z_y^E\right)$, the donor tariff (t) and the geometric average tariff (st), but decreases with both country endowments and the recipient tariff. The equation to be estimated is given by

$$T_{ij} = \alpha_0 + \alpha_1 Z_{y_{ij}}^E + \alpha_2\gamma_j + \alpha_3\mu_i + \alpha_4 s_j t_i + \epsilon_{ij} \tag{33}$$

where T_{ij} represents the amount of aid given by the donor i to the recipient j and Z_{ij} is the recipient imports. Endowments γ and μ are measured by their respective GDPs; $s_j t_i$ is the square of the geometrical average tariff of any pair of trading partners (here, a donor and a recipient), while ϵ_{ijt} is the error term. α_0, α_1, α_2,α_3, α_4, α_5 are unknown parameters to be estimated.

To capture the effect of the asymmetry in endowment size, I replace γ_j and μ_i in (34) by their ratio γ_j/μ_i, which is estimated by GDP_j/GDP_i. Then, I also estimate this equation

$$T_{ij} = \alpha_0' + \alpha_1' Z_{y_{ij}}^E + \alpha_2'\frac{\gamma_j}{\mu_i} + \alpha_3' s_j t_i + \epsilon_{ij}' \tag{34}$$

Comparative statics for trade equations (15) and (16) reveal that aid and endowments have a positive effect on the donor exports, contrary to tariffs. Mathematically, $\frac{\partial Z_y^E}{\partial T} > 0$, $\frac{\partial Z_y^E}{\partial \gamma} > 0$, $\frac{\partial Z_y^E}{\partial \mu} > 0$, $\frac{\partial Z_y^E}{\partial s} < 0$, $\frac{\partial Z_y^E}{\partial t} < 0$ and $\frac{\partial Z_y^E}{\partial (st)} < 0$; donor imports are positively related to countries' endowments but negatively related to aid and tariffs; it is verified that $\frac{\partial Z_x^E}{\partial T} < 0$, $\frac{\partial Z_x^E}{\partial \gamma} > 0$, $\frac{\partial Z_x^E}{\partial \mu} > 0$, $\frac{\partial Z_x^E}{\partial s} < 0$, $\frac{\partial Z_x^E}{\partial t} < 0$ and $\frac{\partial Z_y^E}{\partial (st)} < 0$ (see appendix for derivations). Table 5 below summarizes the comparative statics for the three equations to be estimated.

Table 5. Comparative statics

	Dependent Variables		
Regressors	T	Z_y^E	Z_x^E
Z_y^E	+		
T		+	-
γ	_	+	+
μ	_	+	+
s	_	_	_
t	+	_	_
st	+	_	_

Trade equations are estimated by

$$\begin{cases} Z_{x_{ij}}^E = & \beta_0 + \beta_1 T + \beta_2 \gamma_j + \beta_3 \mu_i + \beta_4 s_j t_i + \varepsilon_{ij} \\ Z_{y_{ij}}^E = & \mathcal{A}_0 + \mathcal{A}_1 T + \mathcal{A}_2 \gamma_j + \mathcal{A}_3 \mu_i + \mathcal{A}_4 s_j t_i + \iota_{ij} \end{cases} \tag{35}$$

As with the aid equation, I assess the impact of recipient countries' relative size on trade; (36) becomes

$$\begin{cases} Z_{x_{ij}}^E = & \beta_0' + \beta_1' T + \beta_2' \frac{\gamma_j}{\mu_i} + \beta_3' s_j t_i + \varepsilon_{ij}' \\ Z_{y_{ij}}^E = & \mathcal{A}'_0 + \mathcal{A}'_1 T + \mathcal{A}'_2 \frac{\gamma_j}{\mu_i} + \mathcal{A}'_3 s_j t_i + \iota_{ij}' \end{cases} \tag{36}$$

Results are obtained by various estimation methods (OLS, Pooled OLS with clustered robust standard errors (POLS), GLS random effects (RE)); for trade models, I also use the Poisson pseudo-maximum-likelihood (PPML) method developed by Santos Silva and Tenreyro (2006)). As it is common in aid and trade literature, I consider different specifications by adding dummy variables for colonial ties and common language, whose coefficients are expected to be positive. To address the simultaneous causation between aid and trade (imports or exports), I use one period lagged variables, which are considered good instruments, uncorrelated with the error term (Anderson, 1979, p. 111; Wooldridge, 2000, p. 517).

I use the standard measure of foreign aid, namely Official Development Assistance (ODA) given by official agencies of the members of the Development

Assistance Committee (DAC) to stimulate economic development and well-being in the recipient countries. The trade and GDP data come from the UNCTAD database (2012) available online. The data are measured in constant 2005 U.S. dollars.[17] Geometric average tariff data comes from Duval and Utoktham (2011). Colonial ties dummy data are taken from Head, Mayer and Ries (2010), while the common language dummy comes from Santos Silva and Tenreyro (2006); this source is supplemented with the online *Encyclopédie Larousse* for countries not included in their sample. Lastly, the ethnolinguistic fractionalization (*elf1*) index is taken from Desmet, Ortuño-Ortin and Wacziarg (2012). The variable *relsize_ GDP* is computed as the ratio of the ACP recipient's GDP to the EU donor's GDP ($GDP\,cap\,ACP/GDP\,cap\,EU$). Table 6 provides data summary statistics; *res_ depend.* measures a recipient's dependence on primary exports, and is the ratio of an ACP primary exports to an EU donor to the ACP's GDP.

The analysis covers a panel of 60 ACP countries and 15 European donors. The data set consists of 2868 observations of bilateral aid and trade flows for the period 2005-2010. Since the focus of this study is on the determinants of foreign aid, only observations with a positive net ODA have been included.

Table 6: Description of data used in the analysis

Variables	N	Mean	Std. dev.	Min	Max
lnaid	2868	15.02	2.34	8.96	21.83
lnimports	2826	9.47	2.37	0.11	15.92
lnexports	2734	8.11	3.30	0.01	15.45
Gdp cap_ ACP	2868	1399.14	2295.02	124.80	16552.13
Gdp cap_ EU	2868	39170.93	13116.15	18131.26	88563.02
res_ depend.	2544	0.006	0.015	8.92e-10	0.282
relsize_ GDP	2868	0.040	0.070	0.001	0.639
g_ av_ tariff	1533	1.125	0.070	1	1.300
elf1	2867	0.175	0.192	0	0.614
Colonial ties	2868	0.101	0.302	0	1
Language	2868	0.205	0.404	0	1

Notes: This table presents basic statistics for the variables used in the analysis.

The appendix contains sources and descriptions of the variables.

[17] Following Younas (2008), I use the unit value of the world import index to convert aid data into constant US $ 2005.

3.2 Results

I begin with the determinants of aid given by equation (35). Table 7 reports the main estimation results. Column (1) is an OLS regression of log aid on a constant, the log of ACP imports, the geometric average tariff, a dummy variable for colonial ties and the recipient relative size. The estimation shows a statistically and economically significant relationship between aid, on the one hand, and imports, colonial ties and recipient relative size. The estimate suggests that ACP imports have a modest impact on EU aid, compared to other factors. The coefficient of this variable is only 0.5. Colonial ties play a more important role in explaining aid than imports, since its coefficient is 1.27. Finally, the relative size variable appears to be the most import determinant of aid allocation; its coefficient is 13.2.

Column 2 presents the POLS estimates of the same equation. Coefficients are same as in column (1), although the standard errors are higher. However all variables remain significant at the same level. Moving from (P)OLS to Random RE in column (3) reduces the estimated effect of imports and the relative size. The results now suggest that a smaller impact of ACP imports on EU aid (its coefficient is 0.3). The coefficient of the relative size variable is also smaller (-11.3). Colonial ties appear to have a higher impact on the EU aid allocation to ACP; this suggests that looking at the aid-colonial ties nexus using (P)OLS understates rather overstates the impact of colonial ties. Its coefficient is 1.7.

Additional variables have been added in Column (4). Given the high correlation between the common language dummy and colonial ties (0.66), the latter is removed from the OLS estimation. The estimated effect of ACP imports on EU foreign aid on EU donors is higher (0.6) than columns (1) and (2), while the impact of relative size is lower (-12.7). Having a common language seems not to be a great motivation for EU donors as being an ex-colony is; its coefficient is 0.7. Multi-ethnic countries seem to receive more EU aid, while resource dependent ones receive less; indeed, *elf1* and *res_depend.* coefficients are 0.1 and -0.2 respectively. In both cases, they statistically insignificant.

In column (5), the relative size variable is broken into its two components, namely *Gdp cap_EU* and *Gdp cap_ACP*. EU aid increases with the former, but decreases with the latter. Recipient GDP per capita has been used in the literature as an indicator of recipient needs (Feeny and McGillivray, 2008; Younas, 2008); its effect on aid is negative as expected, but marginal (-0.0003), while the relative size measure proves to be the most important determinant of EU foreign aid.

Throughout all the regressions (1)-(5), imports, the recipient relative size and colonial ties are very significant at 1 percent level, contrary to the geometric average tariff, which is insignificant. *G_avg_tariff* has the expected sign in column (3)-(5).

Table 8 reports the results of the trade equations (37) to which colonial ties

have been added. Starting with A. EU exports to ACP, the POLS estimation in column (1) shows that the relative size measure is the strongest determinant of EU exports to ACP. This variable has a coefficient of 9.2. Colonial ties seem to be more export-promoting than EU aid; coefficients of these variables are respectively 0.9 and 0.4. The geometric average tariff has negative effect on trade: the model suggests that one percent increase of the tariff reduces ACP imports by 4.8 percent.

Column (2) gives the RE estimates of the same equation, which lead to the same conclusion. However, moving from POLS to RE decreases the estimated impact of aid and the size index, while raising the effect colonial ties. Coefficients of *lnaid1*, *relsize_GDP* and *colonial ties* are respectively 0.1, 6.1 and 1.8. Column (3) gives the PPML estimate brings the same qualitative results. Compared to (1) and (2), all variables are strongly significant at 0.01 percent level; in the previous estimation, the tariff variable is significant at 10 percent. Breaking down the size index into two variables shows that EU imports increase with ACP GDP per capita, but decreases with EU GDP per capita. Although coefficients are very low, this finding is very instructive of the fact that poor countries account for a small share of rich countries' exports trade. Moreover, poor countries' consumption of rich countries' products increases with their income. Compared to estimation (1), the coefficient of the tariff variable has doubled, at the expense of the GDP measure.

The above observations are also valid for EU imports from ACP (table 8.B). It is easily seen through estimations (5) to (8) that all variables tend to have higher coefficients compared to its corresponding equations (table 8.A). Comparing each equation in B with its counterpart in A, it turns out that R-squared are very much lower in the EU import equations than EU export equations.

Results obtained throughout this paper are robust to various estimation methods.

Table 7. Dependent Variable: lnaid, 2005 to 2010.

	(1) OLS	(2) POLS	(3) GLS-RE	(4) OLS	(5) OLS
lnimports1	0.515 ***	0.515 ***	0.318 ***	0.569 ***	0.565 ***
	(0.028)	(0.050)	(0.043)	(0.030)	(0.030)
Gdp cap_EU					0.00003 ***
					(5.18e-6)
Gdp cap_ACP					-0.0004 ***
					(0.00003)
relsize_GDP	-13.211 ***	-13.211 ***	-11.268 ***	-12.678 ***	
	(0.930)	(1.850)	(1.628)	(0.966)	
G_avg_tariff	-0.042	-0.042	0.115	1.105	1.144
	(1.454)	(2.418)	(1.419)	(1.521)	(1.519)
Colonial ties	1.273 ***	1.273 ***	1.682 ***		1.258 ***
	(0.176)	(0.247)	(0.261)		(0.175)
Language				0.701 ***	
				(0.143)	
elf1				0.009	
				(0.287)	
res_depend.				-0.220	
				(3.807)	
Constant	10.642 ***	10.642 ***	12.258 ***	8.771 ***	7.606 ***
	(1.712)	(2.919)	(1.787)	(1.786)	(1.884)
R-squared	0.35	0.35	0.37	0.33	0.36
Obs. (N)	1 210	1210	12010	1150	1 210
AIC	4 913.65	4 913.65		4688.37	4 896.81

Note: Estimated with heteroscedasticity-robust standard errors. Superscripts ***, **
and * indicate significance 1, 5 and 10 % levels, respectively.

Table 8. ACP-EU trade, 2005-2010.

Dep. Var.:	A. Ln (EU Exports to ACP)				B. Ln (EU Imports from ACP)			
	POLS	GLS-RE	PPML	POLS	POLS	GLS-RE	PPML	POLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnaid1	0.438 ***	0.075 ***	0.045 ***	0.422 ***	0.492 ***	0.082 ***	0.057 ***	0.462 ***
	(0.039)	(0.018)	(0.002)	(0.034)	(0.059)	(0.026)	(0.004)	(0.052)
Gdp cap_EU				-0.0006 ***				-0.0001 ***
				(8.25e-06)				(0.00001)
Gdp cap_ACP				0.0002 ***				0.0002 ***
				(0.00004)				(0.00005)
relsize_GDP	9.202 ***	6.129 ***	0.882 ***		13.504 ***	10.407 ***	1.391 ***	
	(1.578)	(1.417)	(0.083)		(0.259)	(2.147)	(0.116)	
G_avg_tariff	-4.834 *	-3.930 *	-0.502 ***	-8.383 ***	-7.877 **	-0.932	-0.952 ***	-14.339 ***
	(2.572)	(2.068)	(0.159)	(2.217)	(3.876)	(2.729)	(0.267)	(3.408)
Colonial ties	0.936 ***	1.827 ***	0.081 ***	0.827 ***	1.452 ***	2.273 ***	0.139	1.293 ***
	(0.194)	(0.248)	(0.009)	(0.188)	(0.342)	(0.349)	(0.018)	(0.350)
Constant	8.322 ***	12.800 ***	2.138 ***	15.184***	9.522 **	7.917 **	2.291 ***	21.695 ***
	(3.055)	(2.338)	(0.189)	(2.164)	(4.469)	(3.135)	(0.311)	(3.902)
R-squared[1]	0.35	0.23	0.35	0.45	0.26	0.18	0.26	0.38
Obs. (N)	1212	1212	1212	1212	1203	1203	1203	1203
Num. of clusters	317	317		317	316	316		316
AIC	4643.58			4436.26	5742.29			5519.23

Note: Estimated with heteroscedasticity-robust standard errors. Superscripts ***, ** and * indicate significance 1, 5 and 10 % levels, respectively. 1: adj. R-squared for POLS; Pseudo R-squared for PPML.

4 Conclusion

The goal of this paper has been to shed light on different types of transfers in a North-South pure exchange model. I have shown that an efficient trade agreement (ETA) leads to free trade only if countries are symmetric. Contrary to conventional wisdom, I find that the ETA is such that the North subsidizes its imports, while the South sets a tariff higher than the Nash level when countries are asymmetric. In this case, the South makes a transfer to the North to compensate for the loss. This first result shows that a transfer is equivalent to a compensation payment when one trading partner loses in a trade agreement.

Once signed, the agreement needs to be self-enforcing in the absence of a supra-national authority. Drawing from Limão and Saggi (2008, 2011), I show that the WRP fines are higher for the small country (the South) than the large one (the North) and increase with the asymmetry in endowment size. This finding sheds light on a second type of transfer, which is actually a compensation payment for infringement.

Finally, I consider another type of transfer, namely foreign aid. In trade literature, aid is given to promote donor exports and reforms in the South. In this paper, I have shown that foreign aid serves as a device for the North to encourage trade liberalization in the South and thus to establish global free trade.

It is widely believed that trade agreements between asymmetric countries only benefit small countries than large partners, as the agreements grant them access to wide markets. My findings bring some qualifications to this view. As shown in this article, the ETA causes a welfare loss in the North, while the FTA benefits both trading partners - contrary to most trade models in literature. It is worth noting that large countries such the EU or the US are often the initiators of trade agreements with their smaller partners, some of which are important suppliers of primary products vital to their industries. Given the increasing competition from emerging economies like China or India, the proliferation of commercial treaties between the EU or the US with developing countries is, among other things, a testimony of their "raw material diplomacy". In fact, the EU and the US seek to secure access to raw materials by eliminating export restrictions.

The systematic analysis of transfers presented in this paper is based on a North-South pure exchange model which abstracts from the supply-side of the economy by assuming some given endowments of goods. Moreover, both countries are assumed to have similar demand functions. Empirical facts suggest that countries differ in their supply capacities and their demands, which inevitably affect trade. A promising avenue for future research would be to take into account heterogeneity in demand and supply within a trade agreement model and examine its effects on trade, countries' welfare and transfers.

5 Appendix

5.1 The 15 European-DAC donors in the sample

Austria	Germany	Netherlands
Belgium	Greece	Portugal
Denmark	Ireland	Spain
Finland	Italy	Sweden
France	Luxembourg	United Kingdom

5.2 The 61 Aid recipient countries from ACP in the sample

Angola	Djibouti	Liberia	Sierra Leone
Antigua and Barbuda	Dominican Republic	Madagascar	South Africa
Barbados	Equatorial Guinea	Malawi	Sudan
Belize	Eritrea	Mali	Suriname
Benin	Ethiopia	Mauritania	Swaziland
Botswana	Fiji	Mauritius	Togo
Burkina Faso	Gabon	Mozambique	Trinidad ad Tobago
Burundi	Gambia	Namibia	Uganda
Cameroon	Ghana	Niger	United Republic of Tanzania
Cape Verde	Guinea	Nigeria	Vanuatu
Central African Republic	Guinea-Bissau	Papua New Guinea	Zambia
Chad	Guyana	Rwanda	Zimbabwe
Comoros	Haiti	Saint Lucia	
Congo	Jamaica	Sao Tome and Principe	
Côte d'Ivoire	Kenya	Senegal	
Dem. Rep. of the Congo	Lesotho	Seychelles	

5.3 Data sources

Variables	Data source
Net aid from 15- EU DAC member countries of OECD	World Development Indicators (WBI, 2011), online access at http://data.worldbank.org/indicator
GDP	UNCTADSTAT (2012), online access at http://unctadstat.unctad.org
Imports	UNCTADSTAT (2012), online access at http://unctadstat.unctad.org
Exports	UNCTADSTAT (2012), online access at http://unctadstat.unctad.org
G_avg_tariff	Duval and Utoktham (2011)
Colonial ties	Table A.4 of Head, Mayer and Ries (2010)
Common language	Table A.2 of Santos Silva and Tenreyro (2006) supplemented with the Encyclopédie Larousse, online
Ethnolinguistic fractionalization (ELF1)	Desmet, K., Ortuño-Ortin, I. and Wacziarg, R. (2012)

Correlation between variables

	lnaid	Gdpcap_ACP	Gdpcap_EU	lnimports	lnexports	g_avg_tariff	Colony	Language	elf1	res_depend.	relsize_GDP
lnaid	1.0										
Gdpcap_ACP	-0.24	1.0									
Gdpcap_EU	-0.01	-0.03	1.0								
lnimports	0.44	0.21	-0.31	1.0							
lnexports	0.30	0.23	-0.34	0.70	1.0						
g_avg_tariff	0.09	-0.22	-0.09	-0.03	-0.02	1.0					
Colony	0.29	0.08	-0.08	0.31	0.27	0.02	1.0				
Language	0.21	0.03	0.09	0.21	0.15	0.01	0.66	1.0			
elf1	0.01	0.24	0.06	0.18	0.14	-0.08	-0.02	-0.04	1.0		
res_depend.	0.05	0.13	-0.13	0.17	0.44	-0.02	0.24	0.17	-0.02	1.0	
relsize_GDP	-0.09	0.97	-0.16	0.08	0.05	-0.13	-0.06	-0.04	0.16	-0.08	1.0

Comparative statics of North-South aid allocation and trade

	Aid allocation decision T	the North's imports (the South's exports) Z_x^E	the North's exports (the South's imports) Z_y^E
Z_y^E	$\frac{\partial T}{\partial Z_y^E} = \frac{3t[1+\mu+3s+(2-\mu)st]}{\left[1+\mu+(2-\mu)st-(1-st)Z_y^E\right]^2} > 0$		
T		$\frac{\partial Z_x^E}{\partial T} = \frac{-3s}{1+3s+\mu+st(2-\mu)} < 0$	$\frac{\partial Z_y^E}{\partial T} = \frac{3t(1+\mu+3s+st(2-\mu))}{[1+T+\gamma+3t+st(2-T-\gamma)]^2} > 0$
γ	$\frac{\partial T}{\partial \gamma} = -1$	$\frac{\partial Z_x^E}{\partial \gamma} = \frac{1+\mu+st(2-\mu)}{1+3s+\mu+st(2-\mu)} > 0$	$\frac{\partial Z_y^E}{\partial \gamma} = \frac{3t(1+\mu+3s+st(2-\mu))}{[1+T+\gamma+3t+st(2-T-\gamma)]^2} > 0$
μ	$\frac{\partial T}{\partial \mu} = \frac{3t\left[(st-1)Z_y^E-3s\right]}{\left[1+\mu+(2-\mu)st-(1-st)Z_y^E\right]^2} < 0$	$\frac{\partial Z_x^E}{\partial \mu} = \frac{3s[1+\gamma+T+3t+(2-T-\gamma)st]}{[1+3s+\mu+st(2-\mu)]^2} > 0$	$\frac{\partial Z_y^E}{\partial \mu} = \frac{1+\gamma+T+st(2-\gamma-T)}{1+T+\gamma+3t+st(2-T-\gamma)} > 0$
s	$\frac{\partial T}{\partial s} = -\frac{3t(2-\mu+Z_y^E)(1+\mu-(1+t)Z_y^E)}{\left[1+\mu+(2-\mu)st-(1-st)Z_y^E\right]^2} < 0$	$\frac{\partial Z_x^E}{\partial s} = -\frac{3(1+\mu)[1+\gamma+T+(2-\mu)T]}{[1+3s+\mu+st(2-\mu)]^2} < 0$	$\frac{\partial Z_y^E}{\partial s} = -\frac{3t(2-\gamma-T)(1+\gamma+T+(2-\mu)t)}{[1+T+\gamma+3t+st(2-T-\gamma)]^2} < 0$
t	$\frac{\partial T}{\partial t} = \frac{3t(1+\mu-Z_y^E)\left[(2-\mu)s+(1+s)Z_y^E\right]}{\left[1+\mu+(2-\mu)st-(1-st)Z_y^E\right]^2} > 0$	$\frac{\partial Z_x^E}{\partial t} = -\frac{3s(2-\mu)[1+\mu+s(2-\gamma-T)]}{[1+3s+\mu+st(2-\mu)]^2} < 0$	$\frac{\partial Z_y^E}{\partial t} = -\frac{3(1+\gamma+T)(1+\mu+s(2-\gamma-t))}{[1+T+\gamma+3t+st(2-T-\gamma)]^2} < 0$
st	$\frac{\partial T}{\partial (st)} = \frac{3(2-\mu+Z_y^E)(1+\mu-(1+t)Z_y^E)}{\left[1+\mu+(2-\mu)st-(1-st)Z_y^E\right]^2} > 0$	$\frac{\partial Z_x^E}{\partial (st)} = -\frac{3(2-\mu)[1+\mu+s(2-\gamma-T)]}{[1+3s+\mu+st(2-\mu)]^2} < 0$	$\frac{\partial Z_y^E}{\partial (st)} = -\frac{3(2-\gamma-T)(1+\gamma+T+t(2-\mu))}{[1+T+\gamma+3t+st(2-T-\gamma)]^2} < 0$

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