# Proliferation of preferential trade agreements: an empirical analysis

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# Proliferation of Preferential Trade Agreements: an Empirical Analysis*

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**Comments Welcome**

**Abstract**

The creation of a preferential trade area (PTA) or the deepening of an existing one can affect adversely excluded countries and induce them to join or create a new PTA [Baldwin, 1993]. One such adverse effect is trade diversion, the shift of imports from countries outside the preferential trade area toward member countries. This paper investigates empirically whether countries whose exports are more likely to suffer from trade diversion exhibit a higher likelihood of forming a PTA. I derive a measure of the potential of trade diversion from the trade complementarity index of Michaely [1962] and estimate a dynamic probit model of new PTAs formed between 1961 and 2005. The results show that countries facing a larger potential of trade diversion are more likely to form a PTA in the future. The results also support the natural trading partner hypothesis according to which preferential trade agreements are more likely to be formed among countries that are predisposed to trade a lot.

**Keywords:** Preferential Trade Agreements, domino theory, trade diversion, Trade complementarity index, Probit.

**JEL Classification: F15, C11, C15, C25.**

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# 1 Introduction

The proliferation of Preferential Trade Agreements (PTAs) is one of the major phenomena in the multilateral trading system over the recent decades. As of June 2014, the World Trade Organization (WTO) has received some 585 notifications of regional trade agreements, of which 379 were in force.[1] Surprisingly, this recourse to regionalism is taking place at a time when world trade flows have reached unprecedent levels, prompting some interrogations about whether they are stumbling blocks or stepping stones to a world of globally free trade (see for instance Frankel and Wei [1996], Limão [2006] or Bhagwati [2008]).[2]

The empirical analysis usually focuses on their long-term determinants. Baier and Bergstrand [2004] found that the potential welfare gains and the probability of PTA formation between two countries are higher for countries that are closer in distance, remote from the rest of the world, larger and more similar economically, and predisposed to gain from their comparative advantage.[3] These findings support the natural trading partner hypothesis according to which preferential trade agreements are formed along the lines of countries that are naturally predisposed to trade largely with each other (see Wonnacott and Lutz [1989], Krugman [1991] and Frankel et al. [1995]). In this view, the decline in transportation cost observed over the last decades is consistent with the proliferation of preferential trade agreements.

The domino theory, an alternative explanation proposed by Baldwin [1993, 1995, 1999] suggests that the trade discrimination faced by excluded countries following the creation of a PTA or the deepening of an existing one can induce them to join or form new agreements. Egger and Larch [2008] (hereafter EL) attempted to address this view by investigating the role of interdependence in PTA formation and enlargement. Interdependence is captured by a measure of geographical proximity of the country-pair contemplating forming a PTA to existing preferential trade areas. Their results suggest that preferential trade agreements that are geographically close are more likely to induce excluded countries to join or seek similar arrangements.

This paper extends their approach to explore a specific channel of interdependence in PTA formation: the diversion of imports away from a non-member partner to a PTA partner. This typically occurs if the duty-free imports from the member partner turn out to be cheaper than

[1] Goods, services and accessions were counted separately. WTO online information, viewed at: http://www.wto.org/english/tratop_e/region_e/region_e.htm.

[2] See also Frankel [1997, chap. 10] or World Bank [2000, chap. 5].

[3] Magee [2003] found similar results and also that countries are more likely to be preferential trading partners if they have significant bilateral trade.

imports from the non-member.[4] The granting of trade preferences creates an asymmetry between firms inside the PTA and firms from the excluded countries, resulting in a loss of exports of the latter. And the more the excluded country exports products that PTA members can import from each other, the higher the risk trade discrimination.

I adapt the trade complementarity index developed by Michaely [1962] to derive a measure of the exposure to such discrimination: the potential of trade diversion. In this context, the index captures to what extent products exported by a country-pair match products that PTA members import from each other. The closer the match, the higher the potential of trade diversion. Using this measure for PTAs that are geographically proximate to the country-pair, I estimate a probit model using five-year interval panel data sets of 161 countries covering the period 1961-2005. The results support the view that country-pairs that are more likely to suffer from trade diversion have a significantly higher probability of forming a PTA. The effect is robust to controlling for EL's measure of interdependence, which is based on geographical proximity with existing PTAs. Also consistent with existing studies, results show that natural trading partners are more likely to form a PTA.

This paper relates to the literature investigating the determinants of PTA formation. Most of the analysis on the "domino theory" are in the context of European countries. In one the introductory papers to the domino theory, Baldwin [1995] discussed some evidence on the domino effect in PTA formation. He argued that the European Community's Single Market Programme constitutes a special threat to countries from the European Free Trade Association (EFTA) because a majority of their exports went to the EC market. This threat may have triggered a "domino effect" leading successively Austria, Sweden, Finland, Norway and Switzerland to seek membership. This was confirmed empirically by Sapir [2001] who was one of the first attempts to take the domino theory to the data.

Baldwin and Rieder [2007] explored empirically the role of trade diversion in the demand of membership for European Union (EU) accession. They captured the domino effect using two variables. The first variable reflects the importance of the EU bloc as a trading partner to the country and is the share of the country's exports that go to EU countries. The second variable captures the deepening of the EU and is a measure of the degree of participation of countries to EU

[4]Such diversion is harmful for the importing country if the pre-tax imports from the excluded country is cheaper than the pre-tax imports from the PTA partner: it is as if the importing country is subsidizing imports from its PTA partner. This effect is coined by Viner [1950] as trade diversion. This side of trade diversion is one of the effects of trade preferences that is covered extensively in the literature. It is so because it is a loss for the world trading system as well since trade is displaced from an efficient supplier to a non efficient supplier.

institutions. They found that both variables have a positive impact on the likelihood of joining the EU. Baldwin and Jaimovich [2010] explored the "contagion" effect in PTA formation, that is the extent to which countries tend to seek PTAs with partners that already have PTAs with their major trading partners. Borrowing from the literature on financial crisis contagion, they used a contagion index that is, for a given country-pair, the share of exports of the reference country that goes to third countries with whom the partner country has a trade deal. They found the contagion effect to be important in PTA formation. The main departure from these papers is that the measure of interdependence variable is not based on aggregate bilateral trade flows. I exploit the availability of product-level data to measure to what extent excluded countries are exporting products that can be prone to trade diversion.

The paper is organized as follows. The next section reviews the literature on the economic effects of PTAs and describes the hypothesis tested in the paper. Section 3 lays out the empirical model, discusses the variables used and the data set. Section 4 presents the results and section 5 concludes.

## 2 Evidence on trade diversion and hypothesis of the study

### 2.1 Trade effects of preferential trade agreements

Since the pioneering work of Viner [1950], the analysis of the economic effects of preferential trade agreements is usually framed in terms of trade creation and trade diversion. There is trade creation when, as a result of trade preferences, imports from a member country replace goods that used to be produced domestically. This leads to an increased efficiency within the preferential trade area as the partner country proves to be a lower-cost producer compared to domestic producers. Although domestic producers will suffer a temporary loss because of competition from the PTA partner, the resources freed can be used more efficiently in another sector where the home country has a relative comparative advantage. In short, trade creation is welfare improving and therefore desirable.

Trade is diverted when imports are shifted away from an efficient non-member supplier to a less efficient member supplier. This typically happens if the duty-free imports from the member country is cheaper than the imports from the non-member partner. Although the domestic consumer is paying less for the same goods, the surplus does not necessarily compensate for the loss in tariff revenue and the importing country ends up being worse off. But the excluded country is also affected as domestic firms are not competing on equal ground with firms in the preferential trade

area.[5] In such case, if it is not possible to join an existing PTA, affected countries may choose to engage in a PTA with other outsiders to mitigate these effects.

In the literature, trade diversion is generally analyzed from the perspective of the PTA member: the question of the desirability of a PTA boils down to a trade-off between its trade creating effect (which is welfare increasing) and its trade diverting effect (which is welfare reducing).[6] In this paper, I take the view of the excluded country and define trade diversion to include broadly a loss of exports due to the presence of a PTA. From the perspective of such country, it matters very little whether the displacement of its exports is going to a more efficient producer or not. This can induce the country either to reduce the price on its exports or to reallocate the resources used to produced the exported goods to another sector. All those adjustments are costly and this cost may feed pro-RTA pressures in order to mitigate those costs.

Although I am looking at trade diversion, it is important to note that there are circumstances under which PTAs can increase trade from non-members. For example, a PTA can raise demand for certain imports from the rest of the world due to complementarity, raising imports from non-members. Also, PTAs can involve further opening of markets to international competition, regulations and policies. The increased efficiency within the preferential trade area can lead to higher income and therefore, larger demand from the rest of the world. I assume that such effects are small compared to the negative externalities and therefore abstract from them.

## 2.2 Hypotheses

The hypotheses of the study are the following:

*Hypothesis 1: Countries that face a higher potential of trade diversion due to the presence of PTAs exhibit a higher probability of forming a PTA.*

The potential of trade diversion is captured by a variable measuring to what extent products exported by a country-pair are also traded within the preferential trade area. If firms from a country-pair are exporting products that are traded heavily by PTA partners, they are more likely to suffer from trade diversion because they are competing against domestic firms enjoying trade preferences.

By focusing on trade diversion, I am investigating a specific aspect of the domino theory. The theory as presented by Baldwin [1993] however does not refer only to trade diversion. It refers to

[5] This is also a cost for the world trading system as this trade is not along the lines of the comparative advantage.

[6] See Frankel et al. [1995] for an analysis of this trade-off in connection with the transportation costs. See also Magee [2008] for a measure of trade creation and trade diversion.

all political-economy forces that can emerge in the excluded country as a result of the formation of a preferential trade area or its deepening. A preferential trade area represents a big market in itself and even in absence of trade diversion, firms from excluded countries may increase lobbying pressure in order to have access to the market. In addition, an increased efficiency within the preferential trade area can raise demand from the rest of the world, but also its attractiveness, and hence the incentives for excluded countries to seek similar deals.

*Hypothesis 2: PTAs are more likely to be formed among natural trading partners.*

This hypothesis emphasizes trade gains as a major determinant of preferential trade deals. Natural trading partners are countries that were already trading a lot prior to the formation of the PTA. This can be due to geographical proximity which is usually associated with low trade cost, complementarity or relative levels of economic development. For such partners, the gains from trade creation are likely to outweigh the loss from trade diversion as suggested by Krugman [1991]. A common proxy of whether countries are natural partners is their bilateral distance. This relies on the fact that trade costs usually increase with bilateral distance and therefore, geographically close countries can be considered as having relatively low trade costs.

# 3 Empirical analysis

The model of PTA formation is a qualitative choice model. Following EL, interdependence is captured by an additional explanatory variable that is function of "ties" with existing PTAs. The main departure from their paper is the measure of those ties. Below, I describe in more detail the approach.

## 3.1 The econometric specification

Let $N = n \times n$ be the number of country-pairs and $\text{PTA}_t^\star$ a $N \times 1$ vector of differential in utility between membership and non-membership of a PTA. $\text{PTA}_t^\star$ is unobservable. Instead we observe $\text{PTA}_t$, which is a vector of dummies whose entries take the value of 1 for country-pairs that are in a PTA in year $t$, including new PTAs (that is $\text{PTA}_{ij}^\star > 0$) and 0 otherwise. I assume that the differences in utility from forming a PTA are function of current and past economic conditions. However, whether a country-pair forms a PTA or not depends on the value of such difference in utility in the previous period. This reflects the fact that the formation of a PTA is typically a long process and agreements entering currently into force are the outcomes of decision taken many years

ago, and therefore triggered by conditions prevailing at that time.

The model of PTA formation is:

$$\text{PTA}^{\star}_{t-5} = \rho W_{t-5}\text{PTA}_{t-5} + X_{t-5}\beta + \epsilon_t \tag{3.1}$$

$$\text{newPTA}_t = \mathbf{1}\left[\text{PTA}^{\star}_{t-5} > 0\right] \tag{3.2}$$

where

- $W_t$ is a $N \times N$ matrix whose entry $\kappa, \tau$ captures the potential of trade diversion faced by exports from country-pair $\kappa = (\kappa_1, \kappa_2)$ in the country-pair $\tau = (\tau_1, \tau_2)$;
- $X_{t-5}$ is a $N \times k$ matrix of $k$ regressors;
- $\beta$ is a $k \times 1$ vectors of parameters;
- $\epsilon_t$ is a $N \times 1$ vector of residual terms;
- $\text{newPTA}_t$ the $N \times 1$ vector such that $\text{newPTA}_{\kappa t} = 1$ if the pair $\kappa$ forms a new PTA in period $t$ and 0 if $\kappa$ was not a PTA in $t-5$ and $t$. Continuing PTAs are excluded from the estimation and the corresponding entry is set to a missing value.[7]
- $\mathbf{1}[.]$ is the indicator function.

The effect of past PTAs on the current ones is captured by $W_{t-5}\text{PTA}_{t-5}$, a variable placing weight on country-pairs that are in a PTA in period $t-5$. The measure gives more weight to existing PTA at time $t-5$ which are more likely to divert trade with the outsider country-pair. The conjecture is that this trade diversion would encourage the outsider to form a PTA 5 years later.

A few remarks are in order. First, in each period we are interested in the effect of pre-existing PTAs on the new ones and the dependent variable is therefore restricted to country-pairs that were not in a PTA in the previous period, that is $\text{PTA}_{it-5} = 0$. This is a restriction compared to EL who estimated separate models for continuing PTAs, new PTAs and PTA enlargement. The restriction however is without a loss of generality since their results did not change much across the three

[7] This trick is used only to keep the vectorial notation consistent. One way to avoid this is to make the dimension of the matrices time-dependent.

specifications. A consequence of this choice is that the number of observations for the dependent variable is declining with time as continuing PTAs are dropped.[8]

Second, I abstract from short-term fluctuations in some of the independent variables by aggregating the panel into 9 periods of five-year intervals covering the period 1961-2005. This has the advantage of increasing the variability in the dependent variable: any agreement created during one of the five years is considered as a PTA formation while the non-existence of such agreement for all the five years is combined into one single observation of no agreement. Each period covers the years $\{t-2,\ldots,t+2\}$ with $t$ taking values in $\{1963, 1968, 1973, 1978, 1983, 1988, 1993, 1998, 2003\}$. With a little abuse of notation, I use the subscript $t$ to denote the 5-year period, and $t-5$ and $t+5$ to denote respectively the previous and the next period.

The model defined by equations (3.1) and (3.2) belongs to the class of models with a spatially lagged dependent variable. A frequent issue with these models is that the spatial lag is usually endogenous and correlated to the error terms, leading to a bias in the coefficient estimates when the endogeneity is not properly taken into account. This specification is however purely a space recursive model as $\text{PTA}_{t-5}$ is pre-determined at time $t$ and there is no serial correlation in the residuals [Ward and Gleditsch, 2008].

## 3.2 Construction of the weighting matrix $W$

The weighting matrix $W$ is derived from $TD$, a matrix whose entries measure the potential of trade diversion between country-pairs, and $D$ a matrix of distances.

### 3.2.1 The potential of trade diversion $TD$

$TD$ is a $N \times N$ matrix measuring the potential of trade diversion faced by exports from a country-pair $\kappa$ in the market of another country-pair $\tau$. To measure this potential, I adapt the trade complementarity index developed by Michaely [1962]. The trade complementarity index was developed originally for comparing trade profiles at country levels: it shows how well the exports structure (supply) of a country matches the imports profile (demand) of a partner. As such, it provides a useful information on the prospects for bilateral trade.

I extend this logic at country-pair level to measure to what extent exports from a country-pair are likely to suffer from trade diversion in another country-pair. The idea is the following:

[8] I assume that those are the only countries that can create a PTA in period $t$ and by doing so, ignore the death of PTAs. In practice, such events are rare in the sample.

if countries $\{\kappa_i\}_{i=1,2}$ are exporting to the world products that are similar to the ones countries $\{\tau_i\}_{i=1,2}$ are importing from each other, the prospect of a trade deal between $\{\tau_i\}$ is potentially harmful to exporters from $\{\kappa_i\}$. The granting of mutual tariff preferences renders bilateral imports between $\tau_1$ and $\tau_2$ cheaper, creating an asymmetry between firms in $\kappa$ and firms in $\tau$: consumers within the preferential trade area are likely to divert their demand away from $\kappa_1, \kappa_2$ to their PTA partner. This asymmetry can nourish politico-forces for the creation of a PTA in $\kappa_1, \kappa_2$.

Formally, let $x^k_{\kappa t}$ be the share of product $k$ in the aggregate exports of $\{\kappa_i\}_{i=1,2}$ to the world and $m^k_{\tau t}$ the share of the same commodity in the imports of $\{\tau_i\}_{i=1,2}$ from each other. The potential of trade diversion faced by exports from $\kappa$ in the market of $\tau$ is defined as:

$$\text{TD}_{\kappa\tau t} = 1 - \frac{1}{2}\sum_k \left| x^k_{\kappa t} - m^k_{\tau t} \right| \tag{3.3}$$

The index ranges from 0 to 1, with 1 reflecting perfect complementarity between exports of $\kappa$ and bilateral imports of $\tau$, and therefore a higher potentiality of trade diversion. The extreme case where the index is zero reflects a situation in which none of the product exported by $\kappa_1, \kappa_2$ are traded between $\tau_1$ and $\tau_2$. In such case, there is no scope for trade diversion since firms from $\kappa$ do not have any competitor in $\tau$. Note that the index is not symmetric: the potential of trade diversion faced by exports from $\kappa$ in the market $\tau$ is not the same as the potential of diversion faced by exports of $\tau$ in $\kappa$.

### 3.2.2 Distance $D$:

The distance between two country-pairs $\kappa$ and $\tau$ is defined as the average distance between all the combinations of two countries from one pair and the other:

$$D_{\kappa\tau} = \frac{1}{4}\sum_{i=1}^{2}\sum_{j=1}^{2} \text{DIST}_{\kappa_i\tau_j} \tag{3.4}$$

where $\text{DIST}_{\kappa_i\tau_j}$ is the bilateral distance between countries $\kappa_i$ and $\tau_j$ measured in kilometers (kms).

I use $D$ here to restrict some entries of the weighting matrix $W$ to zero because its construction is computationally intense. For instance, with 161 countries, $W$ is a $25,921 \times 25,921$ matrix and the memory requirement becomes quickly an issue.

### 3.2.3 The weighting matrix $W$

Given $TD_t$ and $D$, the weighting matrix $W_t$ is defined by:

$$W_t = \text{TD}_t \times \mathbf{1}[D < 2000 \text{ kms}] \tag{3.5}$$

I restrict $W_{\kappa\tau t}$ to be zero for country-pairs that are more than 2,000 kms apart.[9] Rows of $W_t$ are normalized to sum to unity. The main departure from EL is the definition of the non-zero entries of the weighting matrix. In their paper, it is based on the inverse distance ($e^{-D_{\kappa\tau}/500}$) while here, it is based on the potential for trade diversion.

## 3.3 Other Variables

The dependent variable $\text{newPTA}_{ijt}$ is a binary indicator that takes the value of 1 if there is a preferential trade agreement between countries $i$ and $j$ entering in force in period $t$, and 0 if there is no PTA. As discussed previously, the country-pair $ij$ is then dropped from the dependent variable sample and the corresponding entry in the vector newPTA is set to a missing value. As a consequence of this assumption, all the country-pairs that were in a PTA before 1961, the beginning of the period of study were dropped from the analysis.[10]

The explanatory variables are:

- NATURAL (-) is the logarithm of the bilateral distance and captures the natural trading partner hypothesis:

  $$\text{NATURAL}_{ij} = \log \text{DIST}_{ij}$$

  Thee idea is that countries that are closer geographically tend to have lower trade costs and therefore can consume more of each other's varieties. Hence, they have a natural predisposition to trade largely with each other. A trade deal between such countries raises welfare because it is likely to be more trade creating than trade diverting [Krugman, 1991].

- RGDPsum (+) is the sum of real GDP and captures the market size of the country-pair:

  $$\text{RGDPsum}_{ijt} = \log\left(RGDP_{it} + RGDP_{jt}\right)$$

  where $RGDP_{it}$ and $RGDP_{it}$ are real GDP for $i$ and $j$ in year $t$. It is expected to affect

[9] This threshold is also used in Bergstrand et al.'s (2010) analysis of the timing of PTAs.
[10] They were re-included in the dependent variable only if the agreement has broken down.

positively the probability of PTA formation: the larger the market size, the bigger is the scope for trade gains because there are more varieties available for consumption and welfare is increasing with varieties. In addition, there is room for greater competition and specialization.

- RGDPsim (+) measures the similarity between two countries in terms of the economic size:

$$\text{RGDPsim}_{ijt} = \log\left[1 - \left(\frac{RGDP_{it}}{RGDP_{it} + RGDP_{jt}}\right)^2 - \left(\frac{RGDP_{jt}}{RGDP_{it} + RGDP_{jt}}\right)^2\right]$$

The measure ranges from 0 to 1. An index close to 0 reflects an asymmetric country-pair: one of the countries accounts for almost all of the pair's GDP. On the other hand, a value close to zero is indicative that the two countries are of similar size.

- DKL (+/-) is the absolute of the difference in real GDP per capita:

$$\text{DKL}_{ijt} = \log\left|\frac{RGDP_{it}}{POP_{it}} - \frac{RGDP_{jt}}{POP_{jt}}\right|$$

There are opposite views on the relationship between income differences and the likelihood of PTA formation. Krueger [1999] argued that a preferential trade agreement between a developed and a developing country is more likely to improve welfare than one between two similar countries because similar countries have less scope for trade gains based on comparative advantage.

However, from a political economy perspective, preferential trade agreements are more difficult between countries with large differences in income per capita because of possible political opposition in the rich partner.[11] An evidence supporting this argument is the formation of the Canada-US free trade area (CUSTA) and the extension to Mexico (NAFTA). The negotiation of the free trade area between US and Mexico (which will lead to the creation of the NAFTA) faced more opposition from the US House and Senate that the formation of the CUSTA itself (see Beaulieu [2002]).

I also include the square of DKL to capture any nonlinearity in the relationship with income per capita.

- REMOTE(+) measures to what extent a pair of continental trading partners are far from

[11] See Levy [1997] for a discussion of some political economy arguments.

other countries:

$$\text{REMOTE}_{ij} = \text{Continent}_{ij} \frac{1}{2} \left\{ \log \left( \sum_{k \neq j} \frac{\text{DIST}_{ik}}{n-1} \right) + \log \left( \sum_{k \neq i} \frac{\text{DIST}_{jk}}{n-1} \right) \right\}$$

where $\text{Continent}_{ij} = 1$ if $i$ and $j$ are on the same continent and $n$, the number of countries. Welfare of two continental trading partners increases with their remoteness from the rest of the world. The variable takes the value of zero for countries located on different continents.

- DROWKL(+) is a measure of the relative factor endowment between a country-pair and the rest of the world:

$$\text{DROWL}_{ijt} = \frac{1}{2} \left\{ \left| \frac{\sum_{k \neq i} RGDP_{kt}}{\sum_{k \neq i} POP_{kt}} - \frac{RGDP_{it}}{POP_{it}} \right| + \left| \frac{\sum_{k \neq j} RGDP_{kt}}{\sum_{k \neq i} POP_{kt}} - \frac{RGDP_{jt}}{POP_{jt}} \right| \right\}$$

Note that Baier and Bergstrand [2004] use capital-labor ratios. However, due to the availability of data, I follow EL and use differences in real GDP per capita.

### 3.4 Econometric issues

A major issue with the specification in the equation 3.1 is the possible endogeneity of the right hand side variables, especially variables derived from trade values. Since the formation of a PTA takes typically several years during which bilateral ties may have become stronger, anticipation of the trade agreement may increase bilateral trade flows even prior to the agreement itself. In such case, variables derived from trade values are endogenous and correlated to the error term $\epsilon_{ij}$, leading to a bias in parameters.

Magee [2008] showed that there is a significant increase in trade during the four years leading up to the beginning of the average FTA. Here, I take a five-year lagged value for regressors derived from trade values, assuming that the impact of a prospective trade deal five years prior to its entry into force is negligible.

### 3.5 Data sources and measurement issues

The analysis is based on a combination of a variety of data sets. The PTA dummy is obtained from a comprehensive data set assembled by Baier and Bergstrand [2009]. Based on information from the World Trade Organization among other sources, this data set covers 195 countries and provides information on which countries are engaged in any kind of preferential trade arrangement between

1960 and 2005. PTAs include, by increasing degree of integration, non reciprocal preferential trade agreements given by developed nations to developing countries, preferential trade agreements, free trade areas, customs unions, common markets and economic unions. I exclude non reciprocal PTAs from the analysis and group all the others under the terminology of PTA.

Data on bilateral trade flows is from the NBER-United Nations Trade Data constructed by Feenstra et al. [2005]. Combining data from Statistics Canada's World Trade Database and the United Nations Commodity Trade database (UN Comtrade), this database provides information on bilateral imports at 4-digit Standard International Trade Classification (SITC), revision 2 for the period 1962-2000. An interesting feature of this database is that they use primarily the trade flow as reported by the importing country and adopt mirror statistics when such data is not available, thereby increasing the coverage. In the calculation of the trade complementarity index, I aggregate the data to obtain flows at 2-digit SITC level (divisions), yielding 73 items.

The bilateral distance measure is downloaded from the CEPII website.[12] The dataset covers 225 countries and presents, among other distance between the most populated cities or agglomerations in the countries calculated following the great circle formula. Data on real GDP and population are obtained from the World Bank's (2009) World Development Indicators. Real GDP corresponds to GDP measured in 2000 US dollars.

# 4 Results

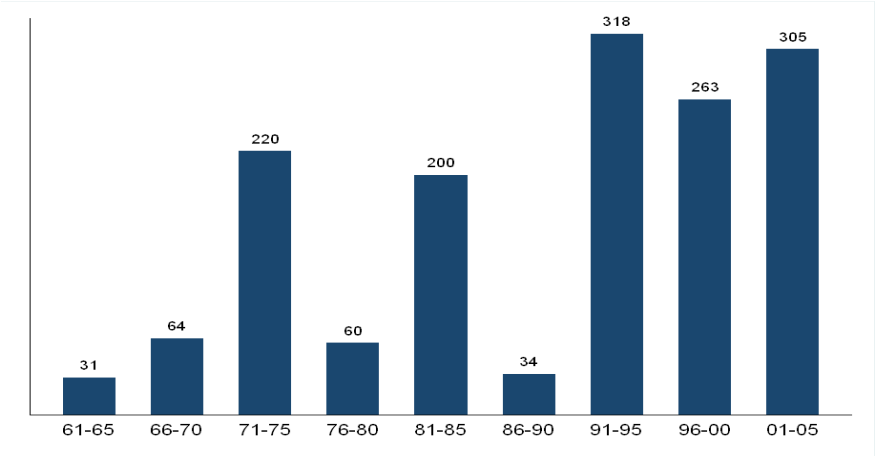
## 4.1 RTA formation and summary statistics

I start with some summary statistics about PTA formation over the period of study. Figure **??** presents the number of country-pairs that have formed a new PTA during each of the 5-years periods from 1961 to 2005. Note that I do not differentiate between bilateral and multilateral PTAs: any enlargement is considered as the creation of a PTA between the new member and each of the existing member. This differs from EL who considered separately the formation of new PTAs from the enlargement of existing ones.[13]

[12] http://www.cepii.fr/anglaisgraph/bdd/distances.htm.

[13] For instance, the accession of Greece to the European Economic Community (EEC) in 1981 is treated as the creation of a bilateral PTA between Greece and each of the countries that were already member.

Figure 1: Number of country-pairs forming a new PTA between 1961 and 2005




Over the whole period of 1961-2005, about 1,499 country-pairs have formed a PTA. From the figure, it is possible to identify periods of active PTA formation and periods of relatively slow PTA formation. For instance, between 1971 and 1975, about 220 country-pairs entered a PTA. This reflects among others the formation of the Caribbean Community[14] and the first enlargement of the European Community with the accession of the United Kingdom, Ireland and Denmark. The second wave of regionalism occured between 1981 and 1985. A major event during this period is the accession of Greece to the EC and the establishment of the Gulf Cooperation Council as a common market between Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates.

Another interesting fact from the figure is that since 1991-1995, the number of new country-pairs forming a PTA remains high, well above 2000. For instance, 318 country-pairs formed a PTA between 1991 and 1995. One could attribute this proliferation to the enlargement of major PTAs such as the European Community because a single country joining one of these PTAs is treated as the creation of as many bilateral PTAs as there are countries. This period is marked by several free trade areas involving the European Community (former EEC) and countries such as Andorra, Bulgaria, Czech and Slovakia, the creation of the Southern Common Market (Mercosur) in Latin America and the creation of the Western Africa Economic and Monetary Union (WAEMU).

However, this was also a period of dynamic regionalism with countries moving towards bilateral trade agreements as well. An indicator that would not be prone to the effect of the enlargement of large preferential trade areas is the number of PTAs notified to the WTO. Such number is not

[14]The Caribbean Community was established in 1973 as a customs union between Barbados, Guyana, Jamaica, and Trinidad and Tobago. Seven countries will join the next year, raising the number of members to 11. These are: Antigua and Barbuda, Belize, Dominica, Grenada, Montserrat, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines. Suriname will join later in 1995 and Haiti in 2002.

affected by the size of multilateral PTAs since bilateral PTAs and multilateral PTAs are counted identically. A study by Crawford and Fiorentino [2005] reported that from 1995 to 2005, 196 new PTAs have been notified to the World Trade Organization, compared to 124 PTAs during the 4 decades of the GATT era. The figure clearly suggests that if there is interdependence, the effects must have been stronger over the last two decades.

Table 1: Summary statistics

| | no PTA | new PTAs |
|---|---|---|
| NATURAL | 8.865 | 7.529 |
| RGDPsum | 24.345 | 24.650 |
| RGDPsim | -2.392 | -1.707 |
| DKL | 1.841 | 1.256 |
| square DKL | 5.021 | 2.377 |
| REMOTE | 1.744 | 6.815 |
| DRWOWKL | -0.245 | -0.242 |

Table 1 presents some summary statistics on the explanatory variables included in the study. Statistics are presented for two sub-samples: country-pairs that are not in a PTA country-pairs that form a new PTA. It shows that countries that form a new PTA are relatively close (NATURAL) and larger compared to the others (RGDPsum). PTAs are also more likely to be observed between countries that are more similar in terms of GDP (RGDPsim) or GDP per capita (DKL). The statistics are descriptive and only indicative of the association between our explanatory variables and PTA formation in the sample.

### 4.2 Estimation results

Table 2 presents the results of the panel data model estimation of the determinants of PTA formation. I report the results under three different specifications. All these specification differ in the weighting matrix used to capture interdependence.

In Column (1) I report the results in a basic specification that does not take into account interdependence, that is, all the elements of $W_{t-5}$ are set to zero. In column (2), I use the distance-based weighting matrix as in EL. It is therefore a replication of their results although I do not differential between PTA formation and PTA enlargement.[15] Column (3) presents results in the case where the weighting matrix is based on the measure of the potential of trade diversion.

[15] Another key difference is that they treat multilateral PTAs as a single country.

Comparing across the specifications, the effects of the common variables are unchanged and in general, not qualitatively different from the other studies such as Baier and Bergstrand [2004] or EL. The results confirm the importance of natural trading partners in PTA formation. The coefficient on the natural logarithm of the bilateral distance in negative and highly significant, suggesting that PTAs are more likely to be formed among countries that are geographically close. I also find that PTAs are more likely to be formed between larger countries ($\hat{\beta}_{\text{RGDPsum}} > 0$) and also countries that are of similar size in terms of their GDP share ($\hat{\beta}_{\text{RGDPsim}} > 0$).

Turning to income differences, I find a positive effect of the difference in income per capita on the probability of PTA formation. However, the coefficient of the square term is negative and significant, suggesting that the relationship is in fact non linear. This is in favor of Krueger's (1999) logic of trade gains based on comparative advantage for countries with different levels of income per capita. EL found a negative coefficient on the difference in GDP per capita and a positive one on the squared-term. The results is however not robust since results from the cross-sectional probit show the reverse sign.

Considering variables measuring the situation of the country-pair compared to the rest of the world, I find that a pair of remote countries (but located on the same continent) are more likely to form a PTA ($\beta_{\text{REMOTE}} > 0$). This support the argument of Frankel et al. [1995] that the welfare from forming a PTA between such pair of countries is higher because there is less scope for trade diversion with the rest of the world. The reason is that such pair of countries is already trading less with the rest of the world because they are more likely to face higher transport costs with such partners.

Table 2: Panel Probit results for the probability of a new PTA, 1966 and 2005

| Dependent variable: newPTAs | | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| $W_{t-5}\text{PTA}_{t-5}$ | | | |
| Trade diversion | | | 1.762** |
| | | | -0.15 |
| Distance-based | | 2.492** | |
| | | -0.208 | |
| NATURAL | -0.820** | -0.733** | -0.684** |
| | -0.036 | -0.036 | -0.036 |
| RGDPsum | 0.206** | 0.217** | 0.192** |
| | -0.014 | -0.015 | -0.014 |
| RGDPsim | 0.190** | 0.197** | 0.177** |
| | -0.018 | -0.02 | -0.018 |
| DKL | 0.236** | 0.216** | 0.193** |
| | -0.06 | -0.064 | -0.06 |
| square DKL | -0.110** | -0.112** | -0.103** |
| | -0.017 | -0.018 | -0.017 |
| REMOTE | 0.037** | 0.041** | 0.037** |
| | -0.005 | -0.005 | -0.005 |
| DRWOWKL | -0.031** | -0.030** | -0.030** |
| | -0.011 | -0.012 | -0.011 |
| Constant | -0.229 | -1.435** | -1.115** |
| | -0.335 | -0.373 | -0.341 |
| Pseudo-R2 | 0.361 | 0.377 | 0.374 |
| Observations | 54 113 | 54 113 | 54 113 |
| Nb of country-pairs | 11 893 | 11 893 | 11 893 |

Notes: Standard errors are reported below the coefficients.
$*$ significant at 5%; $**$ significant at 1%.

I now turn to the interdependence variables. Consistent with EL's finding, country-pairs that are geographically close to PTAs are more likely to form a PTA themselves (column (2)). The coefficient estimate is 2.42 and significant at 1 percent level, a value that is within the the range of their estimates. Results in column (3) point to a significant impact of the potential of trade diversion on the likelihood of two countries forming a PTA. I find a point estimate coefficient of 1.76, supporting the view that countries that face a higher risk of trade diversion due to the presence of neighboring preferential trade agreements are more likely to enter a PTA themselves

the following years. The coefficient is significant at 1 percent level. To measure the goodness-of-fit of the model, I report the pseudo R2. For the model with interdependence, the pseudo R2 is 0.37, suggesting that the model "explains" about 37 percent of variation in the formation of new PTAs.[16]

### 4.3 Robustness check

The measure of trade diversion shares a common feature with EL's distance-based measure: it uses the same criteria to select country-pairs considered as geographically close. Hence, it is possible that the results are driven by a common determinant: distance. To show that this is not the case, I consider alternative specifications including both measures.

Table 3: Panel estimation of PTA formation: marginal effects

Dependent variable: newPTA

| | (1A) | (1B) | (2A) | (2B) | (3A) | (3B) |
|---|---|---|---|---|---|---|
| | Prob. | Marg. | Prob. | Marg. | Prob. | Marg. |
| $W_{t-5}\text{PTA}_{t-5}$ | | | | | | |
| Trade diversion | 0.799** | 0.003** | | 0.0004** | 1.175** | 0.005** |
| | -0.211 | 0.002 | | 0.00009 | -0.281 | 0.002 |
| Distance-based | 1.814** | 0.007** | | 0.0005** | 2.037** | 0.009** |
| | -0.273 | 0.001 | | 0.00011 | -0.296 | 0.002 |
| Interaction of both | | | 4.042** | | -1.688 | |
| | | | -0.397 | | -0.866 | |

Notes: Standard errors are reported below the coefficients.
$*$ significant at 5%; $**$ significant at 1%.

As can be seen from columns (1A) and (3A), the coefficient on the trade-diversion based interdependence variable is positive, supporting the view that this measure captures more than geographical proximity with existing PTAs. The coefficient on the distance-based weighting matrix is however higher, suggesting the predominance of distance in PTA formation. It is important to note that the two effects are not exclusive. For instance, one can think about the trade-diversion based measure as important in inducing countries to seek a PTA, and the distance-based measure as important in their choice of the PTA partner.

The importance of the two determinants is confirmed in columns (1B), (2B) and (3B) reporting the marginal effects of each of the measures. The marginal effects are calculated at the mean of the independent variables and correspond to the effect of these variables on the probability of

[16]The pseudo R2 is calculated as one minus the ratio of the log-likelihood value for the estimated model to that for the model with only an intercept.

a positive outcome. Although these variables are not measuring any economic quantity and the interpretation of their coefficient in isolation does not make much sense, their relative magnitude can be informative. These results show that the interdependence measure based on trade diversion is economically significant, even when distance is controlled for. The marginal effect is significant but roughly half of the effect of the distance-based measure.

Table 3 shows the results of the probit estimation and the marginal effects under three different specifications. I consider a specification including distance-based and trade diversion potential-based measures of interdependence (column (1A)), a specification including only the interaction of the two measures (column (2A)), and a specification including both measures, together with their interaction term (column (3A)). Although included in all the three specifications, the coefficients on the other explanatory variables are not reported to save space.

## 5 Conclusion

In this paper, I extend Egger and Larch [2008] to explore the role of trade diversion in PTA formation. Using product-level trade data, I derive an index capturing to what extent products exported by excluded countries are likely to suffer from trade diversion in preferential trade areas. The index measures the similarity between products exported by the outsiders and products that PTA members import from each other. The closer the match, the higher the potential of trade diversion. I find a significant effect of the threat of trade diversion on the probability of PTA formation. The result is robust to controlling for distance-based measure of interdependence. The results support also the importance of the natural trading partner hypothesis in PTA formation, that is, countries that are closer geographically exhibit a higher probability of entering a PTA.

This paper focuses on a particular aspect of interdependence in PTA formation: trade diversion. However, there are several other aspects that worth exploring, one of them being the terms of trade effects [Kowalczyk and Riezman, 2009, Winters and Chang, 2000]. In addition, as suggested by Baldwin [1993], the deepening of an existing PTA can induce excluded countries to seek similar arrangements as well. All those aspects are left for future research.

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