Free Trade Agreements with cross-country fixed geo-political constraints

Perju, Genoveva-Elena

Unaffiliated

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GENOVEVA ELENA PERJU
GPERJU@GMAIL.COM
HTTP://SSRN.COM/AUTHOR=1224886

Abstract. The paper explores the role of the gravity variables in explaining the FTA-s formation. We develop a new theoretical benchmark for the use of the gravity equation modeling them as fixed resources in the budget constraint of the Nash equilibrium definition of an FTA. We show the existence of an endogenous relationship between gravity variables and bilateral trade so that we code FTA-s as a quantitative variable and we use the simultaneous equations method of estimation on 30195 observations from 1960-2000. There is evidence for bilateral trade being the main determinant of free trade agreements. Other statistically significant relationships are the sharing a common language or common cultural heritages well as being a former colony of the same colonizer which are positively correlated with the FTA formation.

JEL Classification: free trade agreements, gravity equation, Nash equilibrium
Keywords: F13, F53, F59

1. Introduction

The existence of Free Trade Agreements (FTA-s) is frequently associated with globalization or economic growth and it has been also used as precursor of economic integration as for example Europe Agreements with countries from Central East Europe. Nowadays, almost every government concerned with the situation of their country's bilateral external exchanges find themselves confronted with the necessity of choosing between two main policy options, WTO membership and free trade negotiations or not. In this paper we aim to continue the previous work concerning the determinants of Free Trade Agreements integrating these policy options. In particular we address one of the problems previously encountered in the literature in empirically estimating the FTA-s determinants, the endogenous relationship between the variables in the gravity equation of trade and the bargaining country's bilateral volume of trade. Given the policy choices that the governments face we acknowledge the need to use a model allowing for the estimation of both the political and economic nature of trade agreements. Grossman & Helpman (1995) have written one of the most comprehensive studies explaining the politics of free trade agreements in an economic framework which is almost exclusively build up on their relationship with the quantity of output produced and exported by one nation's industries. However, the first attempt to empirically estimate the FTA-s determinants belongs to Baier & Bergstrand (2004) who have been estimating only the economic determinants and they couldn't the bilateral volume of trade in the regression

because of a significant drop in the power of explanation of the model. The method employed has been the same used gravity equation of trade employed based upon a model build to include the transport costs. We show that the unexpected drop in the power of explanation of the model is due to the already mentioned endogenous relationship between the gravity variable and bilateral trade. The most recent example of application of the gravity equation in trade is of Rose (2004) who shows that despite WTO economic rationality to increase trade there is not strong empirical evidence to support it. Another aspect we believe should be take care of in any empirical estimation of agreements is the stability of the negotiated outcome as ensured by the requirement of being a Nash equilibrium. For this we employ the definition of an equilibrium agreement provided by Grosaman and Helpman (1995). Their equilibrium agreement determined through the bargaining over the exclusion of an industry we adapt it for the bargaining over the inclusion or exclusion of a country in the agreement. The Nash solution of the bargaining we use it as a benchmark for modeling the free trade agreements.

2. Theoretical framework

The countries involved in negotiations for the signing of a free trade agreement are$C \in \{1, 2, ..., i\}$. The outcome may be either negotiations breakdown with a probability of α_i or the actual agreement over trade liberalization with the associated probability of $(1 - \alpha_i)$. In negotiations, the governments seek to maximize a common linear objective function $G^{1X2}(p_e) = a^2C^1(p_e) + a^1C^2(p_e) + a^1a^2(W^1(p_e) + W^2(p_e$ subject to the budget constraint $E\left(p_e, FTA\left(p_e, W^C\right)\right) = I(p_e, R)$. Otherwise, the governments choose non-cooperation by maximizing their welfare individually, $G^C = C^1 + a^1W^1$. The outcome of the negotiation is the equilibrium agreement,

$$\max \sum_{C=1,2} n^C \log \left\{ \int \left[\alpha_i G^{CXC} + (1 - \alpha_i) G^C\right] di - G^C \right\}$$

where n^C is a Nash weight attached to the outcome and p_e is the international equilibrium price so that countries evaluate the welfare change from FTA formation taking the world price as given and R are here only fixed resources which we use it as proxy for geopolitical constraints from the gravity equation. It follows that each government evaluates the value of the free trade agreements against the status quo welfare. Note that

$$FTA = \begin{cases} \max \log G^{1X2}, \alpha_i = 1 \\ 0, \alpha_i = 0 \end{cases}$$

where the probability of concluding an agreement is $\alpha_i = 1$ and $\alpha_i = 0$ is the probability of negotiations breakdown. In bilateral negotiations, country 1 evaluates the gain from the maximization of the common governmental welfare function against the maximum value of its individual governmental welfare function. The same reasoning is valid for country 2 too. The solution of the first order condition of the maximization problem is,

$$\log\left\{a^2Y^1 + a^1Y^2 + a^1a^2\left[\left(Y^1 - D^1\right) + T^1 + \left(Y^2 - D^2\right) + T^2\right]\right\} = \log\left[Y^1 + a^1\left(Y^1 - D^1\right) + a^1T^1\right]$$

$$s.t\left(Y^C - D^C\right) = R$$

while Y^C is the internal production potential, $\left(Y^C - D^C\right)$ are the bilateral trade and T^C represents governmental gains from trade, $C \in \{1, 2\}$.

3. Empirical method and the data

We have obtained the same theoretical structure as Baier Bergstrand (2004). However they used the qualitatively dependent variable method of estimation incorporating the budget constraint in the main definition of an equilibrium agreement. Two main problems have been encountered following this method: 1) it was not possible to draw conclusions on the quantitative effects of the regressors and 2) due to bilateral flows endogeneity they have been completely eliminated from analysis. Political determinants have been also completely excluded while from all geo-political variables usually modeled in the gravity equation although most of them statistically significant only the bilateral distance has been found with significant power of explanation in the model. We deal with all these left out remarks within the theoretical framework above. In the first order condition of the FTA maximization problem the logarithm is a useful benchmark to capture the influence of all influences in a single variable. We code the dependent variable as the product of all variables influencing the common welfare (real GDP of both countries as well as the volume of trade and a political dummy variable capturing WTO membership) multiplied by the probability of observing an FTA. The dependent variable coded in this way varies between 0 when there is not an FTA and the maximum value represented by the combined influence of the common welfare variables. We use the properties of the logarithm to multiply all the values but it cannot be applied because of the 0 values assigned to the common gain from FTA formation.

The in dependent variable is the gain from status quo. In other words, the dependent variable measures the gains of non-cooperation so that we code it with the purpose of searching potential conflict within the variables defining the FTA. Therefore, we use as regressors a combination of the real GDP and the volume of trade correlating the economic power with trading potential. Geopolitical constraints in each equation do not vary in time therefore we treat them as fixed using a year dummy variable interacting with each variable from the gravity equation. In order to avoid the problems caused by endogeneity we use the three stages least squares estimate. In the first stage we account for endogeneity between FTA and imports/exports, in the second stage endogeneity between imports/exports and in the last stage we include imports/exports determinant variables.

Data

We collect data from Baier Bergstrand on the existence of an FTA for the period 1960-2000. Data on real gross value of national product is from Pen World Table while data on bilateral trade flow is provided from the project Correlates of War available on internet. Gravity variables are used from the CEPII database. We have 86 countries in the sample grouped 3414 pairs. We have dropped few of the countries from the Baier Bergstrand dataset due to missing GDP data. The bilateral trade flows data includes the missing variables for one important reason. There are many 0 values for

missing trade between countries so that that data cannot be normalized through normal procedures. Since we cannot normalize the data we replace the missing values so that the regressed variables folow a normal distribution. Our main motivation for coding the data with the 0 values included (usually 0 trade flows values are dropped from the analysis) is that exclusion decreases significantly their power of explanation for the non-existence of an FTA while it is not consistent with the reality. The Europe Agreements have been based almost exclusively on the degree of integration in trade between partners which it has changed abruptly from 0 to high values after the collapse in communism in Central East Europe. Indeed, we have counted 8578 bilateral trade 0 values associated with a missing FTA and only 24 bilateral trade 0 values associated with an existing FTA. Moreover, there are 10709 of 0 values for imports associated with the a missing FTA and respectively 11131 of 0 values for exports.

4. Results and discussion

Empirical estimation of bilateral trade has been of much focus and discussion in the economic literature. The most notable contribution is of Baldwin (1971) who use the net exports to estimate Hecksher-Ohlin theoretical framework. Following the Grossman&Helpman (1995) discussion on politics of free trade agreements we are concerned each step whether imports or exports have a greater power of explanation for the signing of an FTA. Since one's country imports are the other countries exports we sort out the influence by checking the robustness of results of imports versus exports. The results of the regression are robust if one country being predominantly importer or exporter doesn't change the statistical relationship between variables of the Nash properties of the outcome of negotiations are verified. Further, $Tradeflows^1 = (GDP^1 * Exports)$ as independent variables represents the first country's exports related to its economical power while $Tradeflows^2 = (GDP^2 * Exports)$ are the second country's imports related to the country 2 economic power as represented by the real GDP. We first estimate empirically the equations,

$$FTA = \beta_0 + \beta_1 \left(GDP^C * \text{Imports/Exports}\right) + \beta_2\, Imports + \beta_3\, Exports + \varepsilon_0$$

$$\text{Imports/Exports} = \zeta_0 + \zeta_1 FTA + \zeta_2 Exports/\,\text{Imports} + \zeta_3 \left(GDP^C * \text{Im}\, ports/Exports\right) + \varepsilon_1$$

$$Exports/\,\text{Imports} = \gamma_0 + \gamma_2 \ln Dis\,\text{t} + \gamma_2 Comborder +$$
$$+ \gamma_4 Samecountry + \gamma_5 Comcolony$$
$$+ \gamma_6 Comlanuageoff + \gamma_7 Comlangethno +$$
$$+ \gamma_8 Curentcolony + \gamma_9 Colony45 + \varepsilon_3$$

We are centering the discussion on the manner trade flows are defined in either imports of exports and we report the desirability and the power of explanation of the gravity variables when the conflict relationship is accounted for. We relate our analysis to country 1 using the variance in country 2 policy choices. Results are reported in

Dependent variable Bilateral FTA	Coefficient	Correlation
Constant	-0.144***	
	(0.004)	
GDP2*Imports	0.226**	0.84
	(0.083)	
Imports	0.451**	0.66
	(0.198)	
Exports	0.196*	0.48
	(0.119)	
Observations	30195	
R2	0.72	
Dependent variable Imports		
Constant	0.041**	
	(0.010)	
FTA	0 .144*	0.82
	(0.084)	
GDP2*Imports	0.688***	0.98
	(0.081)	
Exports	0.233***	0.90
	(0.024)	
Observations	30195	
R2	0.94	
Dependent variable Imports		
Constant	-0.084	
	(0.010)	
lndist1960	- 0.043***	-0.26
	(0.014)	
lndist1965	-0.054***	-0.07
	(0.014)	
lndist1970	-0.034**	-0.03
	(0.014))	
lndist1975	-0.011	0.03
	(0.014)	
lndist1980	-0.036***	0.02
	(0.014)	
lndist1985	-0.035**	0.03
	(0.014)	
lndist1990	0.009	0.06
	(0.014)	
lndist1995	-0.010	0.10
	(0.014)	
lndist2000	0.028**	0.10
	(0.014)	
Observations	30195	
R2	0.09	

*p$\leq 0.10; * * p \leq 0.05; * * *p \leq 0.01$

Endogenous variables: FTA, imports, Exports Exogenous variables: GDP*Imports/Exports, Distance Note: The year dummy variables have been regressed as qualitative variables

Table 1 for the country 2 imports and exports when the country is considered mainly importer. At the same time we are concerned if the coefficients from the regression have the same sign as the one resulting from a simple correlation. There is a positive correlation between the FTA gain from the combined influence of the real GDP and imports. This means that the higher are the economic power associated the more dependent is the country on imports and there is more desirability for the FTA formation. At the same time international trade is balance if higher volumes of imports are associated with higher volumes of exports. Equation 2 confirms this very well know result. In the third equation we include also dummy variables for time and the gravity variables. The greater the distance between the capitals of the bargaining countries there is less desirability for the free trade agreement. This geographical constraint has a constant negative impact on FTA-s over the years while for some years is positively related. The previous analysis suggests that higher volumes of bilateral trade increase the desirability of signing a free trade agreement and the coefficients estimated for the the distance are not stable. In the next section we include the other geopolitical constraints in the regression and we search a stable Nash solution of an equilibrium agreement. Regressors are all dummy variables for being a former part of the same country, sharing a common border, language, ethnography, being a former colony of the same colonizer currently or in 1945. Since all are dummy variable some of them might be interacting with the quantitative ones already included in the model. For instance, when we regress the distance at the same time with sharing the common border, both being geographical constraints in the gravity equation, we find a negative correlation between the desirability of an FTA and common border which is not what we expected. So that we perform the three stages least squares estimate including every gravity variable at a time and we compare stability of the coefficients and the goodness fit of the model for each of them. The results of the regression are presented in the next table.

[Table 2 here]

We found an approximately equal impact from each gravity variable in the model but it should be also noted that sharing common historical background as for example having the same colonizer as regressor improves the goodness of fit of the model and it is one of the gravity variables with the highest impact on the desirability of forming an FTA. In the same order of priorities being currently a colony is an important determinant of FTA-s followed by the geographical variables reflecting the existence of a common border or being a part of the same country. These variables are statistically significant especially for the years of beginning of globalization in 1960-1970 which is a historical period marked by political efforts of reintegration and peace so that is not surprising that neighbors countries or countries formerly belonging to the same entity have searched economic ties for cooperation. Within this group of influences imports have a different type on influence on FTA-s if we change the countries geopolitical characteristics. Higher imports between countries which have had the same colonizer are associated with a lower desirability of trade liberalization as compared with the case of using the geographical distance. The second stage of the regression implies that the result is valid for countries with lower economic power as reflected by a lower real GDP.

The full model suggests the highest goodness of fit for this gravity variables implying that *most of the FTA-s existing today are signed by the less developed countries with common historical background and high imports.* On the contrary, *free trade agreements based on geographical proximity are signed between the most developed countries.*

5. Robustness

Our previous results are confirmed if it can be verified for exports too so that changing players characteristics doesn't change the outcome of the bargaining.

[Table 3 here]

We have found an improved power of explanation of the model when exports are used as determinant of the FTA-s so we proceed further in the analysis using exports. Common colony is still the most significant determinant of free trade agreements but when the geographical distance is used the signs of the coefficients change when the country is considered exporting as compared to importing. When distance is used as regressor the correlation of FTA determinants changes so that the model estimated cannot be a Nash equilibrium. An interesting result follows from the endogenous relationship between imports and exports and the free trade agreement. The second stage least squares estimate suggest that the FTA membership is associated with lower exports resulting probably from the lack of protectionist incentive to export while a lower level of exports is associated with a higher desirability of trade liberalization in the first stage of the estimation. The results are similar for imports and we conclude that *the vicious circle trade flows-free trade agreements relationship promotes free trade globally.* The bilateral volume of trade is likely to be higher for countries that share a common cultural background or have a common official language. Our results confirm the common intuition in concluding international affairs.

6. Conclusion

In this paper we have explored the politico-economic determinants of free trade agreements accounting for the endogenous relationship between variables. Using the Nash equilibrium properties of an equilibrium trade agreement we have been concerned to identify those determinants that show stability of the parameters estimates. The geopolitical fixed and inherited characteristics of a country should not be considering impeding for trade liberalization. On the contrary, the most significant power of explanation for the model is given by the usual economic characteristics (imports and exports) which can be influenced through policy actions. There is a positive correlation between the FTA desirability and the bilateral volume of trade but a negative correlation with the real GDP showing that the global low proliferation of free trade agreements is due to the low level exports associated with the high poverty of the less developed countries. This model is to our knowledge the first attempt of finding stationarity in empirical of free trade agreements through reliance on the Nash concept of an equilibrium trade agreement

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Coeff	Dist	Border	Smctry	Langoff	Comcol	Colony	Com ethno	Curcol	col45
GDP2*Imports	0.226**	1.532***	1.698***	2.317***	0.763***	1.957***	1.957***	1.349***	1.933***
	(0.083)	(0.116)	(0.138)	(0.1104)	(0.142)	(0.114)	(0.114)	(0.148)	(0.120)
Imports	0.451**	-1.945***	-2.158***	-2.732***	-0.481***	-2.614***	-2.716***	-1.589***	-2.615***
	(0.198)	(0.200)	(0.231)	(0.180)	(0.237)	(0.181)	(0.169)	(0.250)	(0.194)
Exports	0.196*	1.351***	1.399***	1.415***	0.635***	1.604***	1.446***	1.160***	1.625***
	(0.119)	(0.119)	(0.125)	(0.105)	(0.126)	(0.105)	(0.103)	(0.134)	(0.110)
FTA	0.144***	-0.288***	-0.331***	-0.321***	0.004***	-0.484***	-0.339***	-0.249***	-0.491***
	(0.084)	(0.064)	(0.067)	(0.021)	(0.033)	(0.084)	(0.022)	(0.071)	(0.096)
GDP2*Imports	0.688***	1.005***	1.057***	1.068***	0.837***	1.108***	1.077***	1.012***	1.121***
	(0.081)	(0.064)	(0.065)	(0.027)	(0.036)	(0.082)	(0.027)	(0.071)	(0.093)
Exports	0.233***	0.309***	0.287***	0.278***	0.200***	0.370***	0.289***	0.257***	0.363***
	(0.024)	(0.023)	(0.023)	(0.022)	(0.023)	(0.027)	(0.022)	(0.023)	(0.027)
1960	-0.043***	0.172**	0.441***	0.0009	-0.536***	0.344***	0	0.814	0.009
	(0.014)	(0.071)	(0.099)	(0.03)	(0.044)	(0.075)	(0)	(0.656)	(0.101)
1965	-0.054***	0.067	0.239**	0.242***	0.034	0.271***	0.248***	0.442	0.145
	(0.014)	(0.072)	(0.100)	(0.03)	(0.044)	(0.075)	(0.029)	(0.656)	(0.102)
1970	-0.034**	0.057	0.205**	0.329***	0.109***	0.243***	0.322***	0.365	0.160
	(0.014)	(0.072)	(0.100)	(0.03)	(0.044)	(0.076)	(0.029)	(0.656)	(0.102)
1975	-0.011	-0.017	0.108	0.195***	0.112***	0.200***	0.176***	0.226	0.203
	(0.014)	(0.072)	(0.100)	(0.03)	(0.044)	(0.076)	(0.029)	(0.656)	(0.102)
1980	-0.036***	-0.045	0.128	0.213***	0.131***	0.246***	0.194***	0.249	0.270
	(0.014)	(0.072)	(0.100)	(0.03)	(0.044)	(0.075)	(0.029)	(0.656)	(0.102)
1985	-0.035**	-0.004	0.107	0.208***	0.126***	0.222***	0.183***	0.228	0.247
	(0.014)	(0.072)	(0.100)	(0.03)	(0.044)	(0.075)	(0.029)	(0.656)	(0.102)
1990	0.009	-0.091	0.077	0.138***	0.070*	0.143***	0.113***	0.160	0.169
	(0.014)	(0.071)	(0.099)	(0.03)	(0.044)	(0.075)	(0.029)	(0.656)	(0.102)
1995	-0.010	0.067	0.007	0.068**	0.016	0.066***	0.045	0.193	0.092
	(0.014)	(0.071)	(0.099)	(0.03)	(0.043)	(0.075)	(0.029)	(0.656)	(0.101)
2000	0.028**	-0.164**	0.045	-0.003	0.020	0.054***	-0.040	0.037	0.096
	(0.014)	(0.072)	(0.099)	(0.012)	(0.044)	(0.075)	(0.029)	(0.656)	(0.102)
R2	0.72	0.64	0.63	0.59	0.75	0.55	0.58	0.69	0.55
	0.94	0.94	0.94	0.94	0.96	0.90	0.93	0.95	0.90
	0.09	0.09	0.09	0.10	0.10	0.09	0.10	0.09	0.09

*p$\leq 0.10; **p \leq 0.05; ***p \leq 0.01$

Coeff	Dist	Border	Smctry	Langoff	Comcol	Colony	Com ethno	Curcol	col45
GDP2*Exports	0.052**	2.663***	1.925***	2.180***	0.972***	1.918***	2.175***	1.916***	1.926***
	(0.095)	(0.101)	(0.106)	(0.099)	(0.122)	(0.092)	(0.092)	(0.109)	(0.091)
Imports	1.196**	1.187***	1.267***	1.137***	0.541***	1.265***	1.184***	1.256***	1.268***
	(0.095)	(0.104)	(0.099)	(0.097)	(0.106)	(0.087)	(0.095)	(0.101)	(0.088)
Exports	-1.898*	-1.877***	-2.210***	-2.301***	-0.579***	-2.202***	-2.340***	-2.193***	-2.213***
	(0.146)	(0.162)	(0.160)	(0.154)	(0.190)	(0.126)	(0.145)	(0.166)	(0.128)
FTA	-0.239***	-0.309***	-0.368***	-0.327***	0.044***	-0.430***	-0.349***	-0.323***	-0.402***
	(0.067)	(0.063)	(0.060)	(0.022)	(0.033)	(0.084)	(0.023)	(0.057)	(0.072)
GDP2*Exports	0.998***	1.080***	1.123***	1.140***	0.904***	1.113***	1.152***	1.088***	1.087***
	(0.081)	(0.069)	(0.065)	(0.030)	(0.038)	(0.082)	(0.030)	(0.063)	(0.079)
Imports	0.273***	0.255***	0.257***	0.215***	0.178***	0.321***	0.226***	0.250***	0.321***
	(0.026)	(0.027)	(0.023)	(0.024)	(0.023)	(0.027)	(0.022)	(0.027)	(0.024)
1960	-0.047***	0.164**	0.433***	-0.005	-0.548***	0.330***	-0.006	0.820	-0.009
	(0.014)	(0.071)	(0.098)	(0.029)	(0.043)	(0.0745)	(0.029)	(0.648)	(0.100)
1965	-0.056***	0.038	0.205**	0.232***	0.104	0.223***	0.237***	0.420	0.094
	(0.014)	(0.071)	(0.098)	(0.029)	(0.043)	(0.074)	(0.029)	(0.648)	(0.100)
1970	-0.035**	0.025	0.167**	0.316***	0.109***	0.190***	0.309***	0.338	0.104
	(0.014)	(0.071)	(0.098)	(0.029)	(0.043)	(0.074)	(0.029)	(0.648)	(0.100)
1975	-0.011	-0.017	0.108	0.195***	0.112***	0.200***	0.176***	0.226	0.203
	(0.014)	(0.072)	(0.100)	(0.03)	(0.044)	(0.076)	(0.029)	(0.656)	(0.102)
1980	-0.047***	-0.068	0.101	0.210***	0.133***	0.209***	0.191	0.229	0.230***
	(0.014)	(0.072)	(0.100)	(0.03)	(0.044)	(0.075)	(0.029)	(0.656)	(0.102)
1985	-0.045	-0.023	0.080	0.203***	0.074*	0.188***	0.182***	0.209	0.209
	(0.014)	(0.071)	(0.098)	(0.029)	(0.043)	(0.074)	(0.029)	(0.648)	(0.100)
1990	-0.0007	-0.094	0.069	0.135***	0.023*	0.138***	0.114***	0.156	0.156
	(0.014)	(0.071)	(0.099)	(0.03)	(0.044)	(0.075)	(0.029)	(0.656)	(0.102)
1995	-0.024	0.059	0.006	0.072**	0.023	0.081***	0.050	0.261	0.101
	(0.014)	(0.071)	(0.099)	(0.03)	(0.043)	(0.075)	(0.029)	(0.656)	(0.101)
2000	0.010**	-0.121**	0.031	-0.0006	0.022	0.052***	-0.045	0.048	0.087
	(0.014)	(0.071)	(0.098)	(0.029)	(0.043)	(0.074)	(0.029)	(0.648)	(0.100)
R2	0.63	0.63	0.60	0.62	0.75	0.60	0.61	0.60	0.60
	0.95	0.94	0.93	0.93	0.96	0.91	0.93	0.94	0.92
	0.09	0.09	0.09	0.10	0.10	0.09	0.10	0.09	0.09

*p$\leq 0.10; **p \leq 0.05; ***p \leq 0.01$