Using a gravity panel data model to estimate recent Cuban external trade[1]

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Abstract

In this paper we examine empirically the magnitude and the main determinants of Cuban bilateral trade flows after the fall of the CMEA commercial (and political) block. To this end we employ a gravity model, adjusted to account for the presence of some "natural" determinants of trade, such as distance and language. In doing so, we estimate also the extent to which some recent measures taken by Cuba to increase the inflow of foreigner investments have generated an increase in external trade. We examined both total trade and trade in distinct product macro categories.

JEL classification: $F10, F12$
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1 Introduction

Gravity models of bilateral trade (first introduced by Timbergen, 1962) have been employed to describe the variations in the volume of trade across countries and over time (see, for example, Leamer and Levinsohn, 1995) so successfully that one can truthfully endorse Anderson's claim (1979, 106) that the gravity equation is the most successful empirical trade device and adopt Everett and Hutchinson (2002, 489) definition of gravity models as "the workhorse for empirical studies" in international economics. In its basic version (Deardorff, 1998: 9) the gravity equation uses income, population and distance as the main factors determining the trade flows among pairs of countries, but does not employ commodities' prices as independent variables given the underling assumption of an homethetic preference structure over consumed goods. In the simplest specification, the gravity equation "fits the data remarkably well empirically, though its theoretical foundations have hitherto been considered limited" (Frankel, et al. 1998: 94). According to some authors it is the presence of increasing return to scale at the firm level what is mainly responsible for the empirical success of the gravity model (Hummels and Levinsohn, 1995). According to some other authors, however, existing empirical evidence can be reconciled with different or even alternative theoretical structural trade models, ranging from Ricardian to constant return to scale Hecksner-Ohlin neoclassical models (Deardorff, 1998). In most cases the gravity model has been used to test the bilateral trade patterns to search for evidence of *i*) the main factors affecting the foreign trade of a country; *ii*) the presence of natural, as opposite to "political", regional trading blocs; *iii*) the existence of trade creation or trade diversion effects from regional integration; *iv*) the extent of the trade potential of a country.

In this paper the gravity equation is employed mainly to investigate the issues under *i*) and *iv*) above with reference to the Cuban economy. Cuba provides an interesting case for this kind of analysis. As it will be discussed in the next section, in the last 15 years Cuba has changed her trade quite dramatically both in terms of partner countries (from CMEA to European Union, Canada and Latin-America) and in terms of the composition of the basket of the traded products. Moreover, the Island no longer benefits from the favorable price conditions for import and export she was used to during the previous 30 years. Under the new conditions created by the fall of CMEA and the consequent dramatic reduction of the Cuban social product, in order to obtain an increase in national income the Cuban authorities had to adopt measures useful to increase both the export of goods and services and - given the low accumulation of capital registered at the end of the 80s - the inflow of productive fixed capital from abroad. All those measures adopted at the beginning of the 90s are part of a process of economic reforms that permitted an appreciable economic recovery that also lead to an increase in the external trade with respect to 1990/91. In this paper we analyse at the empirical level the recent pattern of external Cuban trade, and particularly the effects on this trade pattern of the new legislation on foreign investments, introduced in 1995, that was implemented by means of bilateral investment agreements with a set of foreigner countries. Although these agreements - signed with partner countries of different political, linguistic and economic characteristics - simply determine the incentive conditions for foreign investors to operate in Cuba, yet they might be seen a clue of a new policy orientation of the country in terms of foreigner economic relations.

The paper is organised as follows. In section 2 we discuss the main changes that have taken place in the Cuban economy after the fall of the European Socialist countries and the disintegration of the CMEA block. We stress in particular those aspects most relevant to international trade. In section 3 we introduce and discuss a panel data gravity model for the Cuban trade and justify the choice of the country partners and the sample period. The use of a panel data model allows to overcome some of the statistical criticisms that have been raised against the use of a purely cross-sectional formulation of the gravity equation. The estimation techniques adopted in the paper are discussed in section 4 and in section 5 (and subsections) specific comments on the results found for each product category and for the total aggregate trade are presented. Section 6 contains a discussion of the results obtained by calculating an index of the potential Cuban trade. This index approximate what the future total Cuban trade might be when the USA embargo will hopefully be lifted. Concluding comments and trade policy implications are summarized in section 7.

2 The new trade orientation of the Cuban economy

Since the fall of the CMEA trade block the Cuban economy has undergone substantial structural changes in the economic and institutional spheres (Bosco, 2000; Cole, 1998; Martinez, 1999; Mesa-Lago, 1998). As for trade relationships it should be recalled that in the 1980s more than 80% of the Cuban foreign trade was conducted with the CMEA states and at favorable (mainly, price) conditions. The rupture of these relationships after the political events of 1989 reduced Cuban trade dramatically. In 1993 total import was only 25% of the 1989 value and total export reduced to approximately the 20% of the 1989 value. The GDP, in constant 1981 prices, fell in the same period by a 35%. This slowdown of the economy made the integration into a changing world economy unavoidable and induced the Cuban authorities to introduce serious innovations in the structure and management of the economy. Even some property rights on productive assets were redesigned and a large portion of selected economic activities was delegated in various ways to private entities. Still, a large part of the (severely reduced) Cuban social product depended on foreign trade and this sector of the economy was subjected to reforms, too. First, it was cancelled the long standing state monopoly on foreign trade and then a new non-protectionist custom bill was approved. The former measure gave an unprecedented degree of freedom to all those entities involved in the import and export activity and the latter exposed the Cuban products to international competition on the domestic (food, cloths, etc.) and the international (sugar, nickel, tobacco, tourism) markets. Coupled with a new legislation on direct foreigner investment, the above measures tended to open the Cuban economy to new trade relations, i.e. to find new international partners and to trade over a larger set of products in order to regain at least the level of total trade the Island was used to enjoy before 1989.

During the time period analyzed in this paper (1993-1998) both Cuban GDP and trade volumes have shown a clear tendency to increase but the pace of this recovery may appear somehow slow and unbalanced. The ratio between the 1998 and 1990 values of total trade is approximately equal to 58% but it should be recalled that it bottomed a disastrous 29.7% in 1993 (ONE, 1999). The change in the partnership alluded at the beginning of this section is correlated to changes in the composition of trade. In 1992 total export amounted to 1,779 million *pesos* and foodstuff represented the 78% of the total. In 1998 total export amounted to 1,539 million *pesos*, a value composed for a 50% by foodstuff, 15% by drinks and tobacco, 23% by raw materials (no fuel) and 6% by manufactured goods. In 1992 total import amount to 2,315 millions *pesos*; fuel represented the 36% of the total, foodstuff the 21% and machinery the 18%. In 1998 total import amounted to 4,181 million *pesos*, a value composed for a 16% by fuel, 17% by foodstuff, 27% by machinery, 2% by raw materials (no fuel) and 11% by manufactured goods (ONE, 1999: 126). Apart from suggesting the existence of serious - and increasing over time - trade imbalances, these data are the clear clue of the changes that have taken place in the productive structure of the country in the last ten years and of the new trade policy pursed by the Government.

This new trade orientation of the Cuban economy has occurred in concomitance to a recrudescence of the long-standing unilateral embargo imposed to the Island by the US Government at the beginning of the 1960s. In 1992 and 1996 two new Congress bills (the Torricelli Bill and the Helms-Burton Bill) were approved in order to make trade with Cuba by external branches of US firms and even by non-US firms more difficult. The two bills exposed Cuban (US and no-US) foreigner partners to the risk of serious economic, administrative and legal sanctions on the part of the USA for the mere fact of trading with Cuba.

Everything notwithstanding, the external trade of Cuba has grown and a significant diversification in the composition of this trade has also occurred both in terms of partner countries and in terms of goods and services traded. Given the geographical location of the Island and the newly intensified trade relations with, on the one hand, the countries belonging to the European Union and, on the other hand, with Canada and many Latin-American countries it may be useful: *i*) to analyse empirically the determinants of this new trade flow and *ii*) to test the hypothesis that increasing the degree of openness of the Cuban economy to foreign investors has had a positive effect on the Cuban trade volume. To carry on this analysis different specification of a gravity equation model will be estimated in the next sections. Data availability permits the estimation of the gravity equation at different level of aggregation. This implies that we can analyse not only the determinants of Cuban aggregate trade with her main commercial partners but also the determinants of that trade for specified categories of differentiated goods and services for which different degrees of specialization of the Cuban productive structure can be assumed.

2.1 Intra and/or inter-industry Cuban trade

Before presenting the gravity equation that will be estimated, we first describe some general characteristics of the post-CMEA Cuban trade data. In Fig. 1 and Fig. 2 we plotted the logarithms of the

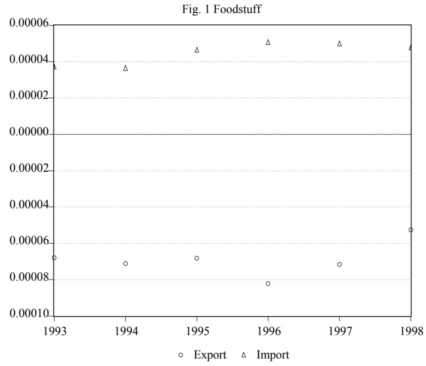
$$(import_{Cuba}/GDP_{Cuba})/\left(TotalProduction_{Cuba}\right)$$

and (with the minus sign)

$$\left(Export_{Cuba}/\frac{1}{5}\sum_{i=1}^{5}GDP_i\right)/\left(TotalProduction_{Cuba}\right)$$

for two classes of commodities: Foodstuff and Chemical products, where the i.s are the 5 main Cuban trade partners for foodstuff and chemicals. In both formulas Import and Export appear as shares. In the case of import the share is computed using Cuban real GDP (1981 prices) and in the case of export the share is computed using the average real GDP of the first five largest importers. In both cases we use total Cuban production as a deflator. In the first case the plot shows almost equally large values of the two ratios, i.e. there is a mirror-like behaviour of the data across the zero line. This is the only case (in our data set) in which such a trend emerges during our sample period.

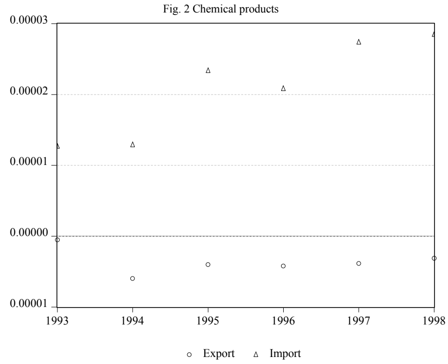
Fig. 1 Foodstuff



We interpret this finding as an indication that *intra-industry* net trade prevails in the case of foodstuff. This is not surprising since foodstuff includes sugar (and derivatives), coffee, fisheries and similar products which are largely exported by Cuba during the sample period. Indeed, foodstuff represents the overwhelming (but decreasing) component of total Cuban export: 75% in 1993 and 50% in 1998. As Antweiler and Trepler (2002: 95) have recently reemphasized trade in similar products is the single most important fact supporting the use of increasing return models in the analysis of international trade. In the case of foodstuff (mainly, sugar) Cuba exports its products also to large producers of foodstuff. The hypothesis that the Cuban foodstuff industry is characterized by the presence of scale economies at plants level is difficult to maintain, however. More likely explanations for the above clues of intra-industry trade in the case of foodstuff might be represented by the presence of what Antweiler and Trepler (2002: 107) call industry-level externalities; by the existence of specific factor endowments (soil characteristics of the cane sugar cultivation) and by the imperfect substitution of similar products (e.g. European beet-root sugar) for Cuban cane sugar.

The second plot documents a dissimilar trend. There is no mirror-like behaviour of the data across the zero line: the export index appears quite stable (and very small) as a percentage of the average GDP of partner countries whilst the import index increases.

Fig. 2 Chemical products



This means that while export remains small and stable during the sample period, the import index increases as a consequence of the increase in the GDP. Fig. 2 is representative of all the sectors included in the present study, except foodstuff. *Inter-industry* trade seems to prevail as a general characteristic of the entire Cuban trade when foodstuff (with sugar included) is not considered. The case of *intra-industry* trade we can document is foodstuff but this is not attributed to the presence of increasing return to scale at the firms level.

3 The gravity model

A basic gravity equation models the bilateral trade as a positive function of the two countries economic size (generally measured by the product of their GDPs) and as a negative function of their geographical distance (Oguledo and McPhee, 1994). Following Frankel et al (1998: 95) we employ also GDP per capita as a regressor - expecting to observe some positive effect on trade arising from this indicator of trade power - and a language dummy, expecting to observe some positive impact on trade induced by language similarity. An important implications of recent works with gravity equations (Kalirajan, 1999: 186) is that a country-specific gravity equation can better explain trade flows between countries than can a cross-country equation, which masks large differences across countries. Mainly for that reason, in this paper the gravity equation we estimate will be specified in the following country-specific panel data log form:

$$\log(TT_{Cuba,,j})_t = \alpha + \beta_1 \log(GDP_{Cuba} * GDP_j)_t + \beta_2 \log(GDP_{Cuba}/pop_{Cuba} \times GDP_J/pop_j)_t + \beta_3 \log(DIST_{Cuba,,j}) + \beta_4(LANG_{Cuba,,j}) + +\gamma(IA_{Cuba,,j})_t + u_{(Cuba,j),t} \quad (1)$$

$$t = 1993, ..., 1998$$

$$j \in N = 1, ..., 13$$

where $TT_{Cuba,j}$ = Total trade defined as the sum of import and export between Cuba and country j; GDP_j = Gross Domestic Product of country j in real terms (1981 prices); pop_j = total population of country j; $DIST_{Cuba,j}$ = Distance between La Habana and the the capital of country j measured in thousands of kilometers; $LANG_{Cuba,j}$ = Binary variable indicating that country j is Spanish speaking; $IA_{Cuba,j}$ = Binary variable indicating the existence of a formal investment agreement between Cuba and country j. Unless differently specified during the estimations, $u_{Cuba,j,t}$ is a zero mean and constant variance error term.

The time period covered by the data is 1993 - 1998. It might be divided into two sub-periods. In the first two years the Cuban GDP grew at a negative rate; in 1994 the rate of growth was slightly above zero and between 1995 and 1998 it was always positive (with a peak of about 7% in 1997). Then, our sample period includes the last years of the severe slowdown and the first years of the recovery when the reforms described in the previous section started to generate some positive effects.

The countries included in the data set are, apart from Cuba: Argentina, Brazil, Canada, Colombia, France, Germany, UK, Italy, Mexico, Netherlands, Portugal, Spain, Switzerland. Their trade with Cuba corresponds to more than the 80% of the total Cuban trade during the sample period. In some specifications of the estimated eq. (1) country dummies will replace the common constant. The selection of these partner countries is neither casual nor entirely dictated by data availability. We tried to include in the date set the major Cuba's partners on both sides of the Atlantic and to pick up both large and small economies as well as developed and developing ones. The choice of the countries also allows us to overcome an important Greenaway and Miller (1986: 109) criticism to the gravity model which consists in the possible inverse correlation between income similarity and distance. In our sample the tendency of countries with similar per capita income to cluster geographically is not strong: the correlation coefficient of non Cuban GDPs and distance is equal to 0.48.

The countries economic size is measured by both GDP and GDP per capita. Trade is supposed to raise when GDP raises, so the latter is expected to have a positive effect on trade: as countries become richer they tend to trade more, and possibly to diversify trade. In our econometric analysis, GDP and population data were collected from statistical tables of UN-ECLAC (various years).

The distance (thousands of kilometers between La Habana and the capital of the partner country) is utilized to test for the role of the geographical location and also as a proxy of transport length and costs and/or other physical obstacles to trade. It is supposed to be negatively correlated to trade volumes[1]. One should note that, as emphasized by Frankel et al. (1998: 95), physical shipping costs may not be the most important component of costs associated with distance. To some extent shipping costs encompass physical transportation costs as well as all those transaction costs associated with a possible lack of a good understanding of the legal and institutional characteristics of non-neighbour trading partners.

The dummy indicating a condition of language communion (it takes value 1 if the partner country is Spanish speaking and value 0 otherwise) is representative of the cultural affinities (e.g. old inter-colonial links) between the countries. We can suppose that a common language could increase the bilateral trade size.

In our specification of the gravity model the dummy variable IA indicates the existence of an investment agreement with a partner country. The possibility of concluding agreements of this kind was made possible by the approval of two recent specific laws (*Ley 77 para la Inversión Extranjera*, 1995, and *Decreto Ley 165 de las Zonas Francas y Parques Industriales*, 1996). Table 1 reports a list of these agreements. As it has been already emphasized they are not proper preferential trade agreements but broad-based investment protection agreements intended to attract new capital and new technologies. The content of these agreements is specifically related to direct foreigner investment activity in Cuba. They imply profit tax and custom preferential treatments and a series of guarantees for profits repatriation and labour costs conditions, specifically reductions of pay-roll taxes. With respect to trade, we assume in the Cuban case the presence of a complementarity relationship between trade and foreign investment and therefore our null hypothesis is that IA has a positive effect on bilateral trade volumes. This assumption is motivated by the fact that the overwhelming part of this flow of fixed investments has taken place in the newly created tourism[2] and foodstuff sectors as

[1] Sharing a common land border should be another dummy regressor of the gravity equation (Frankel, et al. 1998: 94) and it should contribute to increase the trade flows. However, since Cuba is an island we can not consider this dummy in our estimation. In this connection, one should bear in mind that, as it has been emphasised by Porojan (2000), the absence of this variable may lead to an overestimation of the trade flow.

[2] During the 90s, an average of 11% of the total touristic infrastructures belonged to joint

well as in the recently restructured mining sector. They are the most "foreigner oriented" sectors in the Cuban economy. According to some Cuban estimations, exports proceeding from activities supported by foreign investments represented during our sample period a 25% of total export (Everleny Pérez, 1998).

Table 1: *Some of the investment protection agreements*

1	Italy	07/05/93	20	Venezuela	11/12/96
2	Russia	07/07/93	21	Slovenia	22/03/97
3	Spain	25/05/94	22	France	25/04/97
4	Colombia	06/07/94	23	Laos	28/04/97
5	UK	20/01/95	24	Ecuador	06/05/97
6	China	20/04/95	25	Cape Verde	22/05/97
7	Bolivia	06/05/95	26	Jamaica	31/05/97
8	Ukraine	20/05/95	27	Brazil	24/06/97
9	Vietnam	12/10/95	28	Namibia	27/06/97
10	Lebanon	12/10/95	29	Indonesia	10/09/97
11	Argentina	30/11/95	30	Malaysia	26/06/97
12	South Africa	08/12/95	31	Turkey	12/12/97
13	Chile	10/01/96	32	Belize	08/04/98
14	Romania	27/01/96	33	BEL&LUX	19/05/98
15	Barbados	12/02/96	34	Portugal	08/07/98
16	Germany	30/04/96	35	Bulgaria	15/12/98
17	Greece	18/06/96	36	Suriname	12/01/99
18	Switzerland	28/06/96	37	Panama	27/01/99
19	Bolivia	10/11/96	38	Netherlands	02/11/99

Source: Everleny Pérez (1999); Bosco (2000)

Our data on Cuban bilateral trade ($TT_{Cuba,j}$) for the period 1993 through 1998 are drawn from CIA (1999) which contains full-year data available from Cuba's trade partners. Partner trade data include shipping costs in Cuba's exports but not in its imports, the reverse of normal practice. The export tonnages for sugar and nickel are those reported to commodity trade organizations. The data set contains both total trade and trade on specified groups of products. Given the availability of disaggregated data we decided to estimate the gravity model at different degrees of product aggregation (i.e. total trade for all rubrics and trade for most of the categories of traded products) in order to obtain indications about the sensitivity of trade to the regressors in the aggregate and category by category.

ventures established between the Cuban government and foreigner investors and an average of 50% belonged to foreign firms. About half of the no labour inputs employed in the tourism sector are imported and almost the total supply of tourism services are consumed by non Cubans.

Summary statistics of the data used in the regressions are presented in the following Table 2.

Table 2: *Summary statistics (natural logs except DIST)*

	Mean	Variance	Skewness	Kurtosis	N×T
TT	4.68	1.03	- 0.04	1.99	78
GDP	50.40	0.88	- 0.27	2.41	78
GDP/pop	16.72	0.73	- 0.60	2.26	78
DIST	6,969.2	771.021	- 0.96	2.33	78

Finally, two general comments of the estimation strategy.

First, we decided to follow the approach of estimating the gravity equation using Cuban bilateral trade data. We decided not to follow the possible alternative approach of estimating non-Cuban bilateral trade (or using already available estimates of this trade for other countries) and use these estimates to infer the potential Cuban bilateral trade. This choice is mainly motivated, on the one hand, by the peculiarities of Cuban trade relations (see sections 2 and 2.1) and, on the other hand, *i*) by the desire to obtain, as for instance in the Bergstrand (1989) classical paper, estimates from eq. (1) for different categories of traded goods as well as total trade and *ii*) by the possibility that this strategy gives to impose some modification to the general gravity model of eq. (1) to test for the presence of some specific determinants of recent Cuban trade, such as the new policy adopted towards foreigner investments and the presence of the remaining US embargo. *i*) and *ii*) cannot be easily pursed by following the alternative strategy[3].

Secondly, we used a panel data version of the gravity model which includes time invariant explanatory variables to overcome some of the criticisms that have been raised against a pure cross-sectional version of the model. An OLS estimation of cross-sectional gravity equation can be affected by contextual variation over space (i.e. countries) of the data. The result may be that the OLS normality assumptions are violated: the error term may suffer from heteroskedasticity and the parameter estimates could be biased. In the estimation procedure followed in this paper we will explicitly consider this group-wise heteroskedasticity problem.

4 Econometric estimations and tests

For each product category, and for total trade, we proceeded as follows. First, we performed an OLS estimation including GDP, GDP per capita, distance, language and *IA* as regressors. This was estimated in two versions, namely with and without (country) dummy variables to test for the presence of any

[3] A 64 countries version of eq. (1) is used by Selva Paneque (2000) to simulate the future volume of total Cuban bilateral trade with potential regional partners. Results are difficult to interpret, however, given scarce information on the simulation method followed by the author.

time constant country specific effect under the normality assumption about the error term. An F-test of the usual form is conducted to test for the hypothesis that the country effects are the same[4]. We also estimated a pooled panel data version of (1) in the between-groups and random effects formulations. We performed the Hausman test to test for orthogonality of the random effects and the time invariant regressors. As for the investment variable, the null hypothesis that *IA* would cause positive changes in the trade volumes should imply that this variable is able to partially capture some of the disturbance and treat it as a specific component of the equation representing the commercial volume. In what follows we shall call OLSR the regressions estimated by adopting the OLS structure with and without (country) dummy variables and BER and RER the regressions estimated under the panel structure illustrated above.

5 Results

In the following subsections we present the results of the estimation of different specifications of equation (1) for different categories of trading goods (in alphabetic order) and for the total trade. The tables shown in the Appendix report the results we obtained.

As a general comment we may say that the gravity equation is consistent with the data. Trade appears to be significantly affected by GDP but not always by GDP per-capita. The most important cases in which this latter specific measure of economic power is significant are Consumers Goods and Foodstuff, the trade categories where some active role can be assumed for consumers' demand inside the country. If we assume that per-capita GDP approximates better than GDP the capacity to spend income on consumption goods on the part of individuals, it comes as no surprise that this variable turns out to significantly affect trade for these specific trade categories only. By the same token, this explains also the high significance of per-capita GDP as an estimate of total trade (all rubrics) given the fact that the share of the above categories on the total Import and Export are in the range of 75% (see section 2). In other words, per-capita GDP can be expected to be more relevant as a determinant of trade for those products categories for which market mechanisms can be assumed to be more pronounced in contemporary Cuban economy and less significant for those "social" goods (e.g. pharmaceuticals to be used by the still well developed and well functioning National Heath Service) which are still under a strong state control.

Language is strongly significant (apart from Fuels and Raw Materials) as a determinant of trade and this finding accords with many of the empirical

[4] This test has the form

$$F(N-1, NT-N-k) = F(12, 75-k) = \frac{(R_D^2 - R_P^2)/12}{(1-R_D^2)/(75-k)}$$

where D indicated the OLS with individual dummies and P the pooled model and k is the number of the parameters to be estimated (not including the dummies).

results of previous gravity models applied to other trading data set. One should expect this result to be found also in the Cuban case since the Island has somehow managed to maintain or to renew its relations with other Latin American countries and with Spain after the fall of the CMEA block. What might attract attention is the magnitude of the estimated coefficients. In the case of Consumer Goods, for instance, we obtained a coefficient of 2.05.

Distance, although statistically significant in almost all the cases, does not appear in general relevant as an estimate of Cuban trade since the estimated coefficients are nearly zero. We interpret this finding as an indication that Cuban trade is almost inelastic to the variations of shipping and transaction costs associated to distance that we discussed in section 3. We were expecting this result to come out. Since Cuba can not trade with the industrialized potential partner nearest to its coasts, the alternative actual partners (some European Countries and Canada) are situated at almost the same distance from La Habana and therefore small differences should not matter much. It should also be recalled that previous to 1990 the overwhelming majority of the Cuban trade was with the CMEA (long distance) countries. During the 1960s and the 1970s Cuba had restructured its infrastructures (ports, deposits, etc.) to accommodate for the above long distance trade which substituted at the beginning of the 1960s the almost daily trade ongoing with the USA at that time. Therefore, it should be assumed that, since these infrastructures are still in operation, they represent facilities that somehow contribute to the reduction of the costs correlated to distance.

The investment variable is generally significant and it generates an estimated coefficient ranging from 0.01 (Total trade categories) to 0.59 (Machinery). Therefore, it seems that the bilateral investment agreements affected trade positively, particularly in all those sectors such as machinery and fuels where domestic investments were low and the technology inherited from the CMEA period was poor. In same cases we also obtained results that give some support to the hypothesis that foreign investments determined import substitution effect of an appreciable magnitude.

Detailed comments are presented in the following subsections.

5.1 Chemicals

Chemicals in Cuba are mainly imported goods. They comprise: industrial and pharmaceutical products, cosmetics, fertilizers, pesticides, several kinds of plastics and medicines. OLSR produce significant results, especially for the GDP and the idiom variable and the IA variable. All these variables have the expected signs. However, when included, country dummies were not statistically significative. As for BE and RE regression, we can notice that the between-groups R^2 is always the highest one. The null hypothesis of a random disturbance not correlated with the regressors is rejected (at the 25%). However, Hausman tests (for models with and without IA) are accepted which is an indication that in both cases using the GLS as an estimator produces better statistical results.

5.2 Consumer goods

Cuba is a net importer of consumer goods (in our data set they include clothing, footwear, leisure products, etc.). Also in this case the gravity model fits very well the data. In the all statistical specifications of eq (1), GDP, GDP per capita, language and distance coefficients are very significant and show the expected signs. The IA coefficient is significant, too. In the OLSR with dummies, all the country dummies passed the F test illustrated above. In particular, country dummies of Argentina, Mexico and Canada are higher than the other countries' dummies. In the BE and RE regressions ran without IA the fixed effect estimator appears more reliable (consistent), as the Hausman test indicates at the 10% level of confidence. This implies that for this category of products there might exist a structural component in the disturbances of this model. On the contrary, the hypothesis that the $i.th$ observation disturbances are randomly distributed is accepted when IA is included in the estimation. On the basis of this latter result we may say that, for consumer goods, the effect of the investment variable seems to be statistically appreciable also according to the latter estimation procedures.

5.3 Foodstuff

Foodstuff is the product category that Cuba exports on most (this includes sugar, tobacco, honey, molasses, fisheries, several kinds of coffee, etc.). Also in this case the basic gravity model fits very well the available data, mostly with respect to GDP per capita and language. The results of the BE and RE regressions indicate that the fixed effects null hypothesis is always accepted. Coefficients have the expected signs. However, in every statistical specification of eq (1) for foodstuff the investment variable does not look very significant. This result can be commented by saying that the structural component of the gravity model is captured by the fixed effect component thereby reducing the role of IA as an explanatory variable of the variability of trade. Therefore, the investment protection agreements do not appear to influence the data generation process in a statistically significant way. This is not totally unexpected given the fact that in this case foreigner investments are not high and mainly concentrated in the last two years of the sample period.

5.4 Fuels

Cuba is a net importer of fuels since oil reserves are scarce or not yet exploited. Unlike other trade categories, the gravity equation does not fit well the data. In an OLS estimation of eq. (1) run without country dummies the only significant coefficients resulted those of language and distance. Given the fact that Cuba does not export oil (which implies that the dependent variable is given almost entirely by the import volumes), results suggest that the Cuban demand for oil is income inelastic and that imported oil is far short than requirement. After introducing the country dummies the model works a bit better; it passes the F test against the common intercept but differences across countries are very small. The picture is not clearer even after running the

BER and RER regressions. We reject the presence of disturbances randomly distributed among countries.

5.5 Machinery

Cuba is a net importer of machinery (of every kind). The gravity equation of eq. (1) fits very well the data and also the investment variable is significant. On the contrary, the country dummies are not relevant. In the random effects model the Hausman test is accepted at the 5% level of significance. This means that the investment component may capture a part of the disturbance and include it into the common constant, creating an overall positive effect.

5.6 Raw materials

More balanced is the relationship between imports and exports of raw materials (oil not included). In OLSR all the parameters are very significant but country dummies, when included, are not significant. BER produces a very high coefficient for the GDP per capita. In the raw material case the only successful regressions are the OLS ones. In these estimates IA has no particular influence on trade. We were expecting a different result on *a priori* basis, since foreigner investment have abundantly taken place in this sector. Looking at the raw data, however, we have observed that since 1995 there has been a sort of compensating rebalancing path between import and export, with an increase in export balanced by a reduction in import leaving the total trade almost unaffected when measured as a sum of the two components. We can therefore imagine that foreign investments have somehow induced some phenomenon of import substitution in this sector.

5.7 Semifinished products

As for semifinished products (Cuba is a net importer again) all the model specifications works very well; all the coefficients respect the expected signs and are very significant. OLSR with country dummies showed multicollinearity problems, however. The best statistical results are those obtained by the fixed effects specification of the panel structure. We refuse the random effects hypothesis on the basis of the Hausman test and this confirms the presence of structural and not randomly distributed disturbances. Hence, for semifinished products the investment component does not appear to produce a significative influence on trade. Also in this case, however, raw data inspection justifies an interpretation of this finding along the lines already commented upon for the case of raw materials.

5.8 Transport equipment

Transport equipment is almost totally imported. In this case, the most significant variable in the first two regressions is distance, as it was easy to envisage by thinking about the huge dimensions and the heavy weight of the goods belonging to this product category (cars, lorries, etc.). OLSR with country dummies has a very high R^2 and the F test indicates that dummies are significantly different. Both BER and RER produce estimates which are not significant; yet, from the Hausman test we can deduce that for this trade category GLS estimators are preferable and hence that the hypothesis of structural unity disturbances has to be rejected.

5.9 Total trade (aggregate)

Finally, we ran the regressions for aggregate total trade (all categories). OLSR results show very significant coefficients, all having the expected sign. The only exception is IA which is only slightly significant. When included, country dummies pushes the R^2 up, as it is to be expected, but the single dummy parameters are not significant. As for BER and RER, the only significant estimates have been obtained by using the between-groups estimation and are those referred to GDP per capita. All other parameters are not significant. For any specification of eq. (1) we always refuse the hypothesis of randomly distributed disturbances.

6 Cuban potential total trade

As it has been stressed in section 2, Cuban trade is heavily affected by the US embargo. Then, a natural question one may ask is what the Cuban trade might be in the absence of the embargo and, consequently, how much of this potential trade is forgone for Cuba not been allowed to trade with the USA. A way to infer the trade potential is therefore to incorporate in the analysis some measure of the potential trade between Cuba and the USA. Call

$$\widehat{TT_{ij}} = X_{ij}\widehat{\beta}$$

the fitted (log) values obtained from (1) where X_{ij} is the matrix of independent variables and

$$\widehat{TT}_{hUSA} = X_{hUSA}\widehat{\delta}$$

the fitted (log) values obtained from the estimation of (1) using the trade data (excluding the IA variable) of a country h and the USA. Then, if country h is sufficiently "similar" to Cuba a rough index of the Cuban trade potential can be expressed as

$$0 < \frac{\widehat{TT_{ij}}}{\left[\widehat{TT_{ij}} + \widehat{TT}_{hUSA}\right]} \leq 1$$

The denominator measure the total Cuban trade augmented by the fitted trade flow between country h and the USA. Using Distance from Washington, Language and per-capita GDP as indicators of similarities among countries, we decided to use the data of Costa Rica, Mexico and Jamaica for the calculation of the above index. An OLSR was estimated stacking the data by individual blocks and then the fitted values of the dependent variable was retrieved to be used in the calculation of the index. The following table reports the values of the index for some of the years belonging to the sample period.

Table 3 *Values of the trade potential index*

	1993	1996	1998
Costa Rica	0.58	0.56	0.58
Mexico	0.38	0.32	0.40
Jamaica	0.61	0.69	0.68

The range of variability of the index is high and, obviously, country specific. It ranges from a 32% (Mexico in 1996) - meaning that a maximum of about 68% of potential trade is forgone - to a 69 % (Jamaica in 1996), meaning that a minimum of 31% of potential trade is forgone. What might be noted, however, is that the value of the index appears to be either stable or increasing, meaning that the potential trade forgone is, in turn, either stable or decreasing between 1993 and 1998.

7 Conclusions

Since the fall of the CMEA trade block the Cuban economy has suffered a severe slowdown which adversely affected all macroeconomic variables. External trade was dramatically reduced, too. With the approval of economic reforms at the beginning of the 1990s substantial structural changes in the economic and institutional spheres were introduced and some significant economic recovery was obtained. Also the external trade has grown and a diversification in the composition of the trade has also occurred both in terms of partner countries and in terms of goods and services traded. This was permitted, among other things, by the approval in 1995 of a new legislation that liberalized foreigner investments and also by the conclusion with a wide selection of countries of bilateral investment agreements. In this paper we have employed a gravity model to analyse empirically the determinants of the new trade flow of Cuba and to test the hypothesis that the measures taken in order to increase the degree of openness of the Cuban economy had a positive effect on trade volume.

Our main conclusions can be summarized as follows. Basic gravity model predictions of Cuban trade (positive relationship of trade with the economies' size, negative relation with distance and positive relation with cultural affinities) are strongly consistent with our data. The estimated parameters of the product of GDPs, the product of the GDPs per capita, the distance and the linguistic affinities have the predicted signs and are significant. In most cases the investment variable appears to be relevant and a substantial part of the new trade flow can be attributed to the measures introduced to attract foreign capital. The prediction that can be drawn is that in specific cases (e.g. Raw Materials) investment agreements may induce an increase in exports higher than the increase in import. In most of the cases, however, the investment variable comes out to very important as a determinant of total trade and uncorrelated to residuals. With fixed effects, estimated results are more efficient and so we can reasonably say that the differences between countries can be viewed as parametric shifts of the regression function, that is part of the *ith* unity disturbance is captured by constant differences. Since this happens only in specifications of eq. (1) that include the investment variable, this means that the effect of investment variable was otherwise incorporated into the disturbance. When it is brought to the surface (i.e. singled out and included as a regressor), as it should be, it becomes clear that it has a positive and autonomous effect on trade.

We also estimated the potential trade of Cuba if the embargo were lifted. By using data of countries similar to Cuba we estimated a gravity model of their own trade with the USA and employed the fitted values to compute an augmented total trade of Cuba given by the sum of the fitted values of its actual trade and the fitted values of these other countries' trade. We obtained a rough indication of how much total Cuban trade might increase in the absence of the embargo.

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Appendix Regression results

In this Appendix we reproduce some of the regression results used to draw the comments reported in the text (i indicates Cuba)

Tab. A1 Total Trade in *Chemicals* OLSR

VARIABLE	COEF.	S.E.	t	P>|t|	95% Confid	Interval
$GDP_i * GDP_j$	.53	.194	2.706	0.009	[.138,	.914]
$(GDP/pop)_i * (GDP/pop)_j$	.12	.225	.555	0.581	[- .173,	.323]
$LANG_{ij}$	.88	.376	2.358	0.021	[.136,	1.64]
$DIST_{ij}$	- .00008	.00006	- 1.26	0.210	[- .0002,	.00004]
IA_{ij}	.18	.257	0. 496	0.496	[- .690,	.337]
COMM. CONST	- 21.7	10.05	- 2.157	0.035	[- 41.754,	-1.617]

$\bar{R}^2$ = .79; F(5, 69.) = 19; Root MSE = .958

Tab. A2 Total Trade in *Consumers Goods* RER

VARIABLE	COEF.	S.E.	z	P>|z|	95% Confid	Interval
$GDP_i * GDP_j$	.98	.361	2.72	0.007	[- 2.73,	1.69]
$(GDP/pop)_i * (GDP/pop)_j$	1.28	.486	2.64	0.008	[.332,	2.24]
$LANG_{ij}$	2.05	.81	2.5	0.011	[.468,	3.65]
$DIST_{ij}$	-.0003	.0001	-2.25	0.024	[-.0006,	-0.000]
IA_{ij}	0.32	.118	2.71	0.007	[-1.51	1.80
CONST	-68	15.03	-4.53	0.000	[-97.6,	-38.65]

R-Sq (within) = 0.35; R-Sq (between) = 0.46; R-Sq (overall) = 0.44; $\chi^2(4)$ = 34; Prob > χ^2 = 0.000; SD (u_country) = 1.04; SD (e_country_t) = .394; SD (e_country_t + u_country) = 1.11; Hausman (FE vs. RE) H_0 : Difference in coefficients of the first two regressores not systematic $\longrightarrow \chi^2(2) = 4.64$, Prob > χ^2 = 0.099;

Tab. A3a Total Trade in *Foodstuff* FER

VARIABLE	COEF.	S.E.	t	P>|t|	95% Confid	Interval
$GDP_i * GDP_j$	12.15	3.013	4.03	0.000	[6.12,	18.19]
$(GDP/pop)_i * (GDP/pop)_j$	- 14.7	3.68	- 4.00	0.000	[-22.09,	7.35]
$LANG_{ij}$	.87	.372	2.361	0.019	[.12,	1.81
$DIST_{ij}$	.007	0.0002	2.01	0.021	[-.081	.04]
IA_{ij}	.19	.11	1.66	0.10	[-.04,	.43]
CONST	- 362	91	- 3.97	0.000	[-545,	-179]

Country: F(11, 56) = 42.74; Prob = 0.000; R-Sq (within) = 0.28; R-Sq (between) = 0.0005; R-Sq (overall) = 0.0003; F(4, 56) = 5.47; Prob > F = 0.0009;

Tab. A3b Total Trade in *Foodstuff* RER

VARIABLE	COEF.	S.E.	z	P>|z|	95% Confid	Interval
GDP_i*GDP_j	.12	.30	.404	0.686	[-.47,	.72]
$(GDP/pop)_i$*$(GDP/pop)_j$	.35	.41	.84	0.401	[-.46,	1.16]
$DIST_{ij}$	-.00005	.0001	-.38	0.700	[-.0003,	0.0002]
$LANG_{ij}$	.84	.67	1.25	0.209	[.47,	2.17]
IA_{ij}	.10	.12	0.85	0.394	[-.13,	.33]
CONST	-8.4	13.87	-0.64	0.546	[-35.6,	18.82]

R-Sq (within) = 0.06; R-Sq (between) = 0.24; R-Sq (overall) = 0.22; $\chi^2(6)$ = 6.64; Prob > χ^2 = 0.36; SD (u_country) = .75; SD (e_country_t) = .27; SD (e_country_t + u_country) = .80; Hausman (Fe vs. RE) H_0 : Difference in coefficients of the first and last couples of regressores not systematic $\longrightarrow \chi^2(4) = 18.38$, Prob > χ^2 = 0.001;

Tab. A4 Total Trade in *Fuel* OLSR with country DV

VARIABLE	COEF.	S.E.	t	P>|t|	95% Confid	Interval
GDP_i*GDP_j	-13.02	7.38	-1.77	0.086	[-28,	1.96]
$(GDP/pop)_i$*$(GDP/pop)_j$	10.31	9.19	1.12	.27	[-8.37,	29]
$DIST_{ij}$	.075	0.35	2.15	.039	[.004,	.14]
$LANG_{ij}$	-1.11	57.56	-1.94	.061	[-228.65,	5.29]
IA_{ij}	.32	.71	1.89	0.028	[0.001,	1.01]
ARGENTINE	70.04	34.99	2.00	0.05	[-1.05,	141]
COLOMBIA	428	204.60	2.1	0.04	[12.48,	844.29]
MEXICO	473	223.90	2.11	0.04	[18.6,	928.86]
CANADA	287	127.90	2.25	0.03	[28.00,	547.82]
FRANCE	-164	83.50	-1.97	0.06	[-333.98,	5.27]
GERMANY	-228	112.44	-2.03	0.05	[-457.29,	-0.29]
ENGLAND	-151	75.90	-1.99	0.05	[-304.9,	2.67]
ITALY	-218	107.40	-2.04	0.05	[-436.9,	-.39]
NEDERLAND	-197	100.13	-1.98	0.05	[-401.3,	5.68]
PORTUGAL	-93	49.84	-1.87	0.07	[-194.3,	8.26]

$\bar{R}^2$ = .78; F(5, 69.) = 21; Root MSE = .956

Tab. A5a Total Trade in *Machinery* OLSR

VARIABLE	COEF.	S.E.	t	P >|t|	95% Confid	Interval
GDP_i*GDP_j	1.39	.15	9.22	0.000	[1.08,	1.69]
$(GDP/pop)_i$*$(GDP/pop)_j$	.56	.20	2.76	0.007	[.15,	.97]
$DIST_{ij}$	-.0003	.00006	-5.00	0.000	[-.0005,	- 0.0001]
$LANG_{ij}$	.92	.32	2.84	0.006	[.28,	1.56]
IA_{ij}	.59	.23	2.56	0.013	[.13,	1.05]
COMM. CONST	-75.92	7.78	-9.76	0.000	[-91.4,	-60.4]

$\bar{R}^2$ = .55; F(5, 69.) = 20; Root MSE = .956

Tab. A5b Total Trade in *Machinery* RER

VARIABLE	COEF.	S.E.	z	P >|z|	95% Confid	Interval
GDP_i*GDP_j	1.64	.37	4.45	0.000	[.92,	2.37]
$(GDP/pop)_i$*$(GDP/pop)_j$	1.07	.51	2.11	0.035	[.08,	2.08]
$DIST_{ij}$	-.0004	.0001	-2.63	0.009	[-.0006,	- 0.00009]
$LANG_{ij}$	1.49	.84	1.78	0.075	[-.14,	3.13]
IA_{ij}	.21	.14	1.45	0.146	[-..07,	.50]
CONST	-96.7	16.5	-5.85	0.000	[-129,	-64.3]

R-Sq (within) = 0.49; R-Sq (between) = 0.63; R-Sq (overall) = 0.58; $\chi^2(5)$ = 65.37; Prob > χ^2 = 0.000; SD (u_country) = 1.032; SD (e_country_t) = .41; SD (e_country_t + u_country) = 1.11; Hausman (Fe vs. RE) H_0 : Difference in coefficients of the first and last couples of regressores not systematic $\longrightarrow \chi^2(3)$ = 6.29, Prob > χ^2 = 0.0984;

Tab. A6 Total Trade in *Raw Materials* OLSR

VARIABLE	COEF.	S.E.	t	P>|t|	95% Confid	Interval
GDP_i*GDP_j	-1.11	.32	-3.46	0.001	[-1.76,	-.46]
$(GDP/pop)_i$*$(GDP/pop)_j$	2.08	.32	6.53	0.000	[1.44,	2.72]
$LANG_{ij}$	-.85	.51	-1.70	0.097	[-1.87,	.16]
$DIST_{ij}$	- .0003	.00008	-4.18	0.000	[- .0005,	-.0002
IA_{ij}	.21	0.055	3.83	0.000	[.03,	1.00]
COMM. CONST	26.52	14.98	1.77	0.083	[-3.55,	56.6]

$\bar{R}^2$ = .65; F(5, 69.) = 20; Root MSE = .959

Tab. A7 Total Trade in *Semifinished goods* RER

VARIABLE	COEF.	S.E.	z	P >|z|	95% Confid	Interval
GDP_i*GDP_j	1.44	.47	3.03	.002	[.51,	2.37]
$(GDP/pop)_i$*$(GDP/pop)_j$	.85	.63	1.34	.179	[-.39,	2.08]
$DIST_{ij}$	-.0004	.0002	-2.36	.018	[-.0008,	-.00007]
$LANG_{ij}$	1.98	1.08	1.83	.067	[-.14,	4.11]
IA_{ij}	-.02	.14	-.18	.85	[-.30,	.25]
CONST	-82.3	18.9	-4.36	.000	[-119,	-45.4]

R-Sq (within) = 0.38; R-Sq (between) = 0.39; R-Sq (overall) = 0.34; $\chi^2(5) = 36.22$; Prob > $\chi^2 = 0.000$; SD (u_country) = 1.37; SD (e_country_t) = .36; SD (e_country_t + u_country) = 1.41; Hausman (Fe vs. RE) H_0 : Difference in coefficients of the first and last couples of regressores not systematic $\longrightarrow \chi^2(3) = 10.11$, Prob > $\chi^2 = 0.018$;

Tab. A8 Total Trade in *Transport equipment* OLSR

VARIABLE	COEF.	S.E.	t	P>|t|	95% Confid	Interval
GDP_i*GDP_j	-.19	.35	-.054	.96	[-.72,	.68]
$(GDP/pop)_i$*$(GDP/pop)_j$	.57	.39	1.96	.06	[-.17,	1.16]
$LANG_{ij}$	.40	.45	.87	.39	[-.53,	1.33]
$DIST_{ij}$	-.0002	.0000	-3.36	.003	[-.0004,	-.0001]
IA_{ij}	.81	.38	2.11	.041	[.34,	1.59]
COMM. CONST	-5.56	17.3	-.32	.749	[-40,	29.4]

$\bar{R}^2 = .50$; F(5, 69.) = 15; Root MSE = .861

Tab. A9 Total Trade *All Rubrics* OLSR

VARIABLE	COEF.	S.E.	t	P>|t|	95% Confid	Interval
GDP_i*GDP_j	.65	.110	5.93	.000	[.43,	.87]
$(GDP/pop)_i$*$(GDP/pop)_j$	.55	.162	3.42	.000	[.23,	.88]
$LANG_{ij}$	1.07	.243	4.42	.000	[.59,	1.55]
$DIST_{ij}$	-.002	.0004	-4.63	.000	[-.0003,	-.0001]
IA_{ij}	.011	.026	4.10	0.000	[0.001,	.0211]
COMM. CONST	-36.5	5.56	-6.67	.000	[-47.4,	-25.6]

$\bar{R}^2 = .68$; F(5, 69.) = 20; Root MSE = .951