



UNIVERSITÀ DEGLI STUDI DI MILANO

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# **A Gravity Equation analysis of trade integration between Great Britain and the EU**

Thesis presented by  
**Andrea Italiano**

Supervisor  
**Professor Florian Mayneris**

Supervisor and Reader  
**Professor Emanuele Bacchiocchi**

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## **Abstract**

Gravity equations are a staple of international trade analysis and gave rise to a huge literature from the 60's until now.

We use this tool in order to analyse the trade integration of Great Britain with the European Union, employing a dataset taken from the UN Comtrade database, both aggregated and at industry level. The topic is of crucial interest since the vote on 'Brexit', triggered a long process whose aftermath will see Britain leaving the Union and its Single Market.

There is a lot of uncertainty surrounding this unprecedented event, from how much it will take to what kind of future relations will be set up. We choose to identify which are the most vulnerable sectors of British trade, basing on the identified level of integration and the tariffs currently applied by the EU under the WTO trade regime: a scenario that could take place if the two economies will not manage to establish new trade agreements.

We also included a comparison with the other two largest world economies, the USA and China, to better evaluate trade integration with the EU.

The results shows, as expected, a very high degree of integration of Great Britain with the EU meaning the economic shock would be high. This is especially crucial in some sectors of trade as automotive industry, on the other side it should be less painful in some other like the pharmaceutical industry.

**Keywords:** Gravity Equations, Trade Integration, International Trade, Brexit



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# 1. Introduction

With the referendum of the 23<sup>rd</sup> of June 2016, strongly wanted by ex-prime minister Cameron, the British people expressed their desire to exit from the European Union. Until now the new government of Theresa May has not yet decided to trigger Article 50 of the TFEU to start the exit negotiations, despite Juncker recommendations, but there are few doubts that this will happen sooner or later.

Complex negotiations will start after the notification of withdrawal, requiring the unanimity of the EU members: Article 50 provides for two years devoted to consultations, but some estimates indicate that the process could be not completed before at least ten years<sup>1</sup>.

Even though is not easy to figure out which kind of scenario will result after the end of those negotiations, it is sure that, for reasons of political expediency, future profitable concessions given to Great Britain will be hard to achieve.

One of the major consequences of this withdrawal will materialize in Great Britain losing the privilege to trade in the European Single Market at least at the conditions it has enjoyed until now.

We can identify the main benefits to trade granted by a membership of the Union in lowered trade barriers: elimination of tariffs and reduced technical barriers (absence of quotas and tariffs from 1968, reduced paperwork and the Schengen Agreement, for example).

This work puts itself in the perspective of the possible effects of Brexit on trade.

The difficulty in assessing the impact of exiting the union comes for a great part from the uncertainty about which kind of scenario could come out. We will consider the fact that negotiations should take into account the tariff level of trade at WTO regime, one of the possible outcomes.

Trade in services could be hit very hard by this kind of shock and given its importance on British trade balance this is a very vulnerable spot. On the other side, the balance of trade in goods experiences a persistent negative trend since at least a couple of decades and the Brexit could be further detrimental.

With this in mind we try to identify, with the econometric tool of gravity equation, how much is the country integrated with the EU in terms of trade in goods, and more in depth, in which sectors of trade does Britain trade the most with the rest of the Union. Once this is known, it would be easier in the future to assess their potential vulnerabilities and maybe possible to

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<sup>1</sup> HM Government (February 2016). *The process of withdrawing from the European Union*

conceive a global strategy to conduct successful negotiations or gradually modify the British trade pattern to better exploit new opportunities. The analysis takes some further steps into considering not only the the EU but also that with the other two biggest world economies, China and the US, in order to compare the current state of trade integration with them as well as how it evolved over more or less the last couple of decades.

We will use the econometric tool of gravity equation estimation and a Comtrade dataset in order to:

1. First identify an overall level of integration between Great Britain and the EU, then
2. Compare that level with the other from China and the USA;
3. The third point will concern looking at the evolution of the integration coefficients through the years;
4. Decompose trade flows by sectors to identify the integration coefficients at that level;
5. Lastly, try to compare the evolution through the years of British integration in some previously identified key sectors of trade.

At last we will try to draw some general and more sector specific conclusion using all the information obtained.

## 2. Stylized facts on British international trade

Since we are interested in trade integration with EU, we will first show some general features of British international trade, namely its share composition for the main partners under consideration and for the most important goods traded. From these first very simple data we will be able to draw some initial considerations.

### *GBR balance of trade in goods, import and export shares for countries*



Figure 1. Balance of trade (goods)



Figure 2. Balance of trade (goods) with the EU<sup>2</sup>

<sup>2</sup> EU is built basing on the entrance year of each country member

In Figure 1 is reported the balance of trade in goods of Great Britain across the time span under observation. The balance is positive only in year 1993 and since then it is subject to a downward trend, with the lowest level reached in 2012. This highlights a first visible weakness of the British trading regime. Comparing Figure 2 to Figure 1 we can see the weight of the balance of trade with the EU on the general one, meaning the states of the Union are the most important partners of Britain and determine most of its trade deficit.

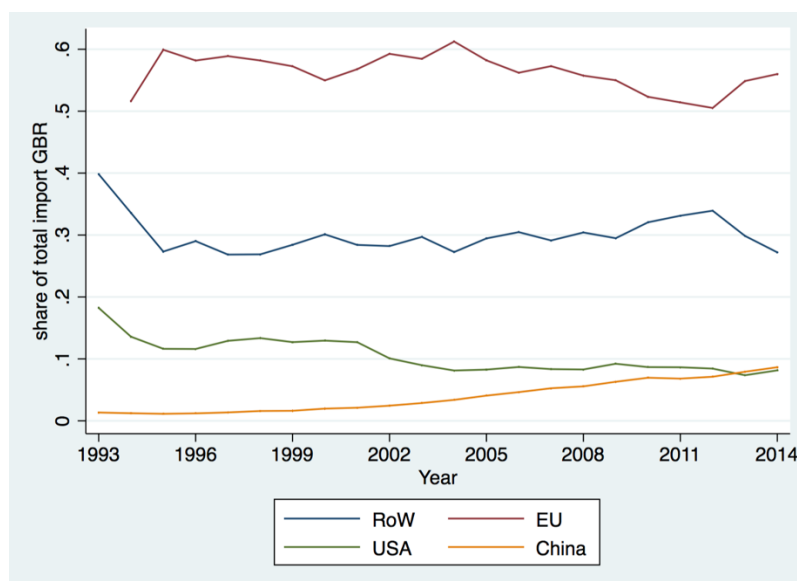


Figure 3. Import shares for trading partners

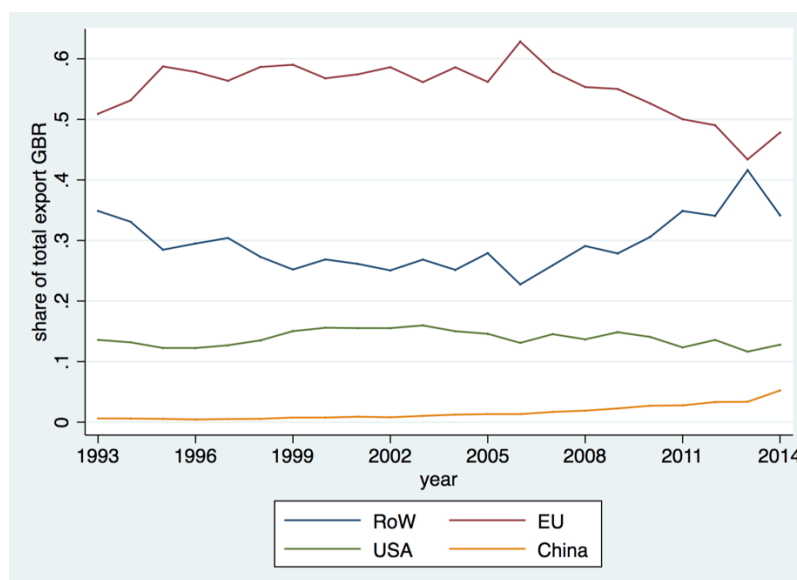


Figure 4. Export shares for trading partners

In Figure 3 and 4 we can look at the shares of British trade partners for what concerns, respectively, import and export. First of all we notice that the three large trade partners (EU,

China and USA) together represent the large majority of import (more than 70%) and export (more than 65%).

The EU shares are around 50%, declining from 2006 for export, meaning the Union remains the most constant partner across the timeframe for both the directions of trade and represents by far the most important trade market for Great Britain.

Chinese shares seem to be growing over time, starting from relatively low levels. The growth becomes visible from the mid-90's reaching and surpassing the level of the US in 2013 for import, while for export it becomes to increase later, from the early 2000's.

The US share for import is declining from almost 20% to less than 10%, exhibiting an opposite trend with respect to China, while it remains stable as export market.

Taking into consideration how trade with the EU shapes general British trade, we see that its deficit might be further worsened by the Brexit, since export would be targeted by custom duties from the start, which can be quantified, as well as by technical barriers, whose impact is rather hard to assess.

The tables also show that the British country suffers a deficit with China, even though export seems to experience an accelerated growth in the last years of observations, which could help to reduce the gap in the future.

The next step will concern the identification of the most important sectors of British trade.

***GBR import and export shares for goods***

| <b>hs2</b> | <b>Description</b>                                                                                                                                                                      |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>22</b>  | Beverages, spirits and vinegar                                                                                                                                                          |
| <b>27</b>  | Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes                                                                                    |
| <b>29</b>  | Organic chemicals                                                                                                                                                                       |
| <b>30</b>  | Pharmaceutical products                                                                                                                                                                 |
| <b>39</b>  | Plastics and articles thereof                                                                                                                                                           |
| <b>48</b>  | Paper and paperboard; articles of paper pulp, of paper or of paperboard                                                                                                                 |
| <b>61</b>  | Articles of apparel and clothing accessories, knitted or crocheted                                                                                                                      |
| <b>71</b>  | Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metal and articles thereof; imitation, jewellery; coin                         |
| <b>72</b>  | Iron and steel                                                                                                                                                                          |
| <b>84</b>  | Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof                                                                                                           |
| <b>85</b>  | Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles |
| <b>87</b>  | Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof                                                                                                 |
| <b>88</b>  | Aircraft, spacecraft, and parts thereof                                                                                                                                                 |
| <b>90</b>  | Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; parts and accessories thereof                                    |
| <b>99</b>  | (Reserved for special uses by Contracting Parties)                                                                                                                                      |

*Figure 5. Description of the most important sectors of British trade from hs2 nomenclature*

| export2014 |       | export1993 |       |
|------------|-------|------------|-------|
| hs2        | share | hs2        | share |
| 84         | 14.07 | 84         | 21.08 |
| 27         | 10.86 | 85         | 11.28 |
| 87         | 10.73 | 87         | 8.63  |
| 71         | 10.67 | 27         | 6.69  |
| 30         | 6.59  | 90         | 4     |
| 85         | 6.29  | 29         | 3.63  |
| 90         | 3.89  | 30         | 3.06  |
| 88         | 3.3   | 72         | 2.73  |
| 39         | 2.56  | 22         | 2.48  |
| 29         | 2.13  | 71         | 2.46  |
| import2014 |       | import1993 |       |
| hs2        | share | hs2        | share |
| 87         | 11.8  | 84         | 15.58 |
| 27         | 11.23 | 85         | 11.81 |
| 84         | 11.15 | 87         | 8.33  |
| 85         | 8.12  | 27         | 5.45  |
| 30         | 5.11  | 71         | 4.86  |
| 71         | 4.93  | 99         | 3.81  |
| 99         | 3.46  | 90         | 3.06  |
| 39         | 2.99  | 48         | 2.74  |
| 90         | 2.74  | 39         | 2.71  |
| 61         | 2.13  | 88         | 2.41  |

*Table 1. Import and export shares for sectors traded*

In Table 1 it is represented the share composition of Britain for the most important goods traded at two-digits level of the Harmonized System (HS): the description of each sector is included in Figure 5<sup>3</sup>. In addition, we made a comparison between 1993 and 2014 in order to see whether this composition had seen some changes, this to see if trade integration could have been influenced by modification of the economic structure of the country. The first thing to do looking at the table is acknowledging intra-industry trade, this is not a surprise since is typical of modern economies. The most comprehensive explanation for this phenomenon is that coming from Krugman's New Trade Theory (Krugman 1980).

<sup>3</sup> For a complete description of all the sectors see the appendix

The most important sectors include advanced manufacturing<sup>4</sup> (84-85-87-88-90), pharmaceutical (30) and energy sectors (27).

Comparing the first and last years of our observations, we can see more or less the same composition of trade, with the presence of the same goods although with different weights. We notice that “Nuclear reactors, boilers, machinery and mechanical appliances” remains the most important for export even though its relative weight has diminished, this also applies for "Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles". Sector 71, "Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metal and articles thereof; imitation, jewellery; coin" has become four times more its 1993 size. "Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes" increased more than 60% and "Pharmaceutical products" more than doubled. Sector 88, representing "Aircraft, spacecraft, and parts thereof" entered the top 10 of exports.

For import, we observe increased dependence on the mineral fuels sector, which doubled its weight, and as it was for export, the sectors including machinery and mechanical appliances (84) and electrical machinery (85), decreased their shares.

If the outcome of Brexit will mean trade under WTO law, this could result in a possible worsening of the already negative balance of trade, as we already said, given that EU trade the most with EU and the impact of possible tariffs and non-tariffs barriers.

One thing to keep in mind the exposition not only in general as a net importer but also due to the position high in the European production chain<sup>5</sup>, which applies more importantly for some specific industries. For example, transport and electrical equipment (84-85-87) and pharma (30) which are crucial for British economy: through our analysis we should be able to uncover a high level of integration between EU and Great Britain, both within the other sectors of trade with the EU and relatively to the same sectors of trade with the other countries under consideration.

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<sup>4</sup> industries which heavily experiences introduction of “new technology, improved processes, and management methods to improve the manufacturing of products” (National Defense University, 2002)

<sup>5</sup> Alicia Garcia-Herrero and Jianwei Xu(December 2016). *Is the UK role in the European supply chain at risk?*,bruegel.org

### 3. Literature

The beginning of the gravity literature can be traced back to the work of Jan Tinbergen (1962) Since then gravity equations have been widely used by researchers for various goals: for example, to assess the impact of trade policies, trade barriers and trade integration.

It is usually applied to trade in goods but can also be used for trade in services as in Kimura and Lee (2006).

The basic intuition behind gravity equations is simple: export is directly proportional to the economic mass of the countries and inversely proportional to trade costs:

$$(1) \quad X_{ijt} = G_t S_{it} M_{jt} \phi_{ijt}$$

In (1)  $X_{ij}$  represents the bilateral trade flows between country  $i$  and country  $j$ ,  $G$  is a constant not depending on the countries but rather on the international economic environment,  $S$  represent all the exporter countries characteristics that make up for the size of the export flow they are willing to supply. On the other side  $M$  represents the specific features of the importer countries that make up for the total of their demand. These are represented by the economic size of the countries. Finally,  $\phi_{ij}$  is the trade cost function, representing the difficulty of accessing the importer market. All the variables can change over time.

Distance is one of the most important arguments of the trade costs function, Disdier and Head (2008) make a review of 103 papers with the aim of analysing the empirical results of the effect of distance on trade, finding a mean effect of about - 0.9, with 90% of estimates placed between 0.28 and 1.55.

A recent paper by Rauch (2016) tries to trace a link between gravity equation used by economists and physics, to investigate the reason why the negative value of distance should be theoretically -1.

Apart from distance, the arguments of the trade cost function can include “[...] any cost of engaging in international trade such as transportation costs, tariffs, non-tariff barriers, informational costs, time costs and different product standards, among others. [...]”<sup>6</sup> of course also incentives to trade may be included in the form of the inverse of trade costs<sup>7</sup>.

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<sup>6</sup> Chen and Novy 2011, p.206

<sup>7</sup> for example: a common language or sharing a border

The equation can be estimated in the simplest way by ordinary least squares (OLS) method which allows to assess the impact of each variable on trade flows.

The variables are taken in log for their additive property in order to obtain a log-linear equation of this form:

$$(2) \quad \ln X_{ijt} = \beta_1 \ln G_t + \beta_2 \ln S_{it} + \beta_3 \ln M_{jt} + \beta_4 \ln \phi_{ijt} + \ln \varepsilon_{ijt}$$

One problem that was experienced in the early phases of gravity works was related to their link with trade theory. At first the Ricardian and Heckscher-Ohlin model seemed unable to take into accounts components such as the effect of economic size. Anderson (1979), was the first to theoretically found gravity equations, basing on the Armington assumption thus that goods were differentiated by the country in which originated. Bergstrand (1984 and 1989) founded the gravity equation basing on Krugman monopolistic competition model.

Finally, the staple among the micro-founded gravity equation became Anderson and van Wincoop (2003) with their ‘Gravity with gravitas’. In a few words, the Anderson and Van Wincoop gravity model represents a demand function. On the consumer side we have preferences displaying constant elasticity of substitution: consumers have “love of variety” preferences. On the production side we have standard Krugman (1980) assumptions: each firm produces a unique product variety with increasing returns to scale. A producer in one country can sell goods domestically or in a foreign country. There are no transport costs to sell locally but only to sell abroad. Consumers consume product varieties coming from all countries, but the prices of foreign produced varieties are adjusted upwards to take into account the cost of moving goods. At equilibrium firms both produce for the local market and engage in international trade, and consumers consume accordingly. The basic model provides expressions for the volume of exports by each firm thus aggregating across firms within an economy then makes it possible to derive an expression for the total value of a country’s exports, which is the dependent variable in the gravity model.

A great novelty introduced by Anderson and van Wincoop concerned the so called *multilateral resistance terms* (MTR). Those terms represent barriers to trade that each country face with all the partners and influence the bilateral trade flows in such a way that a gravity model lacking this specific will not capture. One way to take them into account, suggested by Feenstra (1994) makes use of estimation through single countries fixed effects.

The theoretical gravity equation of Anderson and van Wincoop has this final form:

$$(3) \quad X_{ijt} = \frac{Y_{it} Y_{jt}}{Y_t} \left( \frac{T_{ijt}}{\Pi_{it} P_{jt}} \right)^{1-\sigma}$$

Or taken in logarithms for the OLS estimation:

$$(4) \quad \ln X_{ijt} = \beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 \ln T_{ijt} + \beta_4 \ln \Pi_{it} + \beta_5 \ln P_{jt} + \ln \varepsilon_{ijt}$$

Where in (3)  $Y_i$  and  $Y_j$  represent economic size of countries  $i$  and  $j$  in GDP,  $Y$  the world level of GDP,  $T$  the trade costs of exporting from  $i$  to  $j$ ,  $\Pi$  and  $P$  the multilateral resistance terms of countries  $i$  and  $j$  and finally  $\sigma$  the elasticity of substitution.

A point that needs to be emphasized in relation to the trade costs function is that it is impossible to disentangle the elasticity of substitution from the trade cost elasticity when we estimate the model (see Chen and Novy 2011). This two elements result always multiplied together. This is crucial for a sectorial estimation of trade flows. That is because, for example, we should be careful of comparing two distance coefficients because the differences may be not simply arise reflecting a different sensitivity to distance of the two, but the visible effect could be the result of sector specific elasticity of substitution.

In our work we will use gravity equations to estimate integration specifically at sectorial level trade flows. In the literature trade integration is measured in various ways, one is the so called ‘phi-ness of trade’, a simple ratio between domestic to bilateral trade flows (Head and Ries, 2001, Baldwin et al., 2003, Head and Mayer, 2004). Another method, applied by Chen and Novy (2011) makes use of elasticity of substitution estimates at industry level, in order to identify the real effects of trade costs on trade flows. We will simply measure how much bilateral trade will not be accounted for by the explanatory variables through our gravity equations augmented with dummy variables representing the trade partners of Great Britain, taking account of industry heterogeneity through fixed effects estimation. So that trade integration will represent how much trade flows differ from their theoretically predicted level.

## 4. Methodology

### 4.1 Data

The dataset is taken from the United Nations Commodity Trade Statistics Database (Comtrade) and breaks down trade among 182 exporters and 195 importing partners, across a total of 97 sectors of trade classified according to the two-digits HS. The timeframe goes from 1993 to 2014, for a total of 22 years and 9,440,880 observations. Not every observation is complete with information for all the variables that we are interest in: we will state where the number of observations changes in the estimation of a particular equation.

For what concerns Great Britain, the country under examination, there are a total of 151,701 observations for import and 264,024 for export.

The dependent variable under consideration measures the value of the trade flows in US Dollars, taken in logarithms. There is the presence of a single big outlier in export (2013 good 71 to Switzerland) but running the estimation without them does not impact it in a significant way. There are no problems of zero trade flows to take into consideration, as Santos Silva and Tenreyro (2006), and Hurd (1979), excluding zero values, that cannot be converted in logarithms, could lead to large biases in the estimation.

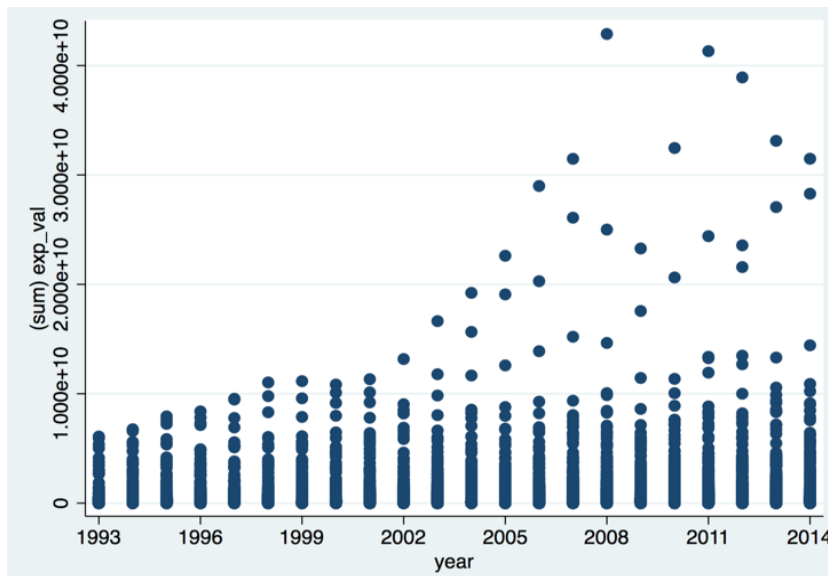


Figure 6. Scatter plot of import trade values

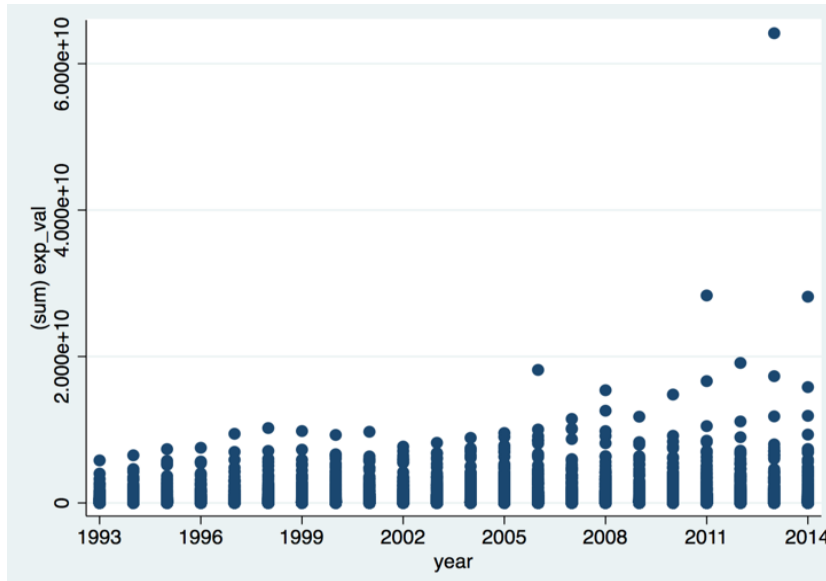


Figure 7. Scatter plot of export trade values

## 4.2 The model

Here we introduce the model used to estimate trade integration. The specifics of our gravity equations will change depending on the aim of the different steps of the analysis.

### *Gravity at aggregated level (0)*

First we build a very simple gravity equation at aggregated level, with all the countries as importers and exporters and fixed effects.

The estimation is run using OLS regression through the STATA software, and the equation will have the following form:

$$\ln X_{ijt} = \beta_0 + \beta_1 \ln S_{it} + \beta_2 \ln S_{jt} + \beta_3 \ln D_{ij} + \beta_4 A + \beta_5 L + \beta_6 C + \gamma_{st} + \varepsilon_{ijt}$$

The independent variables in these first equation will measure:

- (S) Economic size of the countries;
- (D) Distance;
- (A) Adjacency;
- (L) Language;
- (C) Colonial relations.

Size:

It is represented by GDP or per capita GDP and population, not taken together to avoid problems of collinearity.

Distance:

It measures the simple distance (in Km) between the most populated cities of the two trading partners. Size and distance variables are taken in logarithm in order to see them as elasticity.

Adjacency:

This is a dummy variable activating when trading partners share a land border.

Language:

The second dummy variable identifying whether or not two countries share the same official language.

Colonial relations:

The last dummy variable representing countries that ever shared a colonial linkage.

Fixed effects:

We included fixed effects associated yearly to each sector of trade ( $\gamma$ ). We don't have the single estimate for the elasticity of substitution at sectorial level, but in these way we can account for the heterogeneity of the industries, representing their specific costs. Indeed, ignoring the presence of firm heterogeneity tends to amplify the magnitude of trade cost changes on trade flows (Behar, A. and Nelson, D.B., 2012).

Robustness:

We built a cluster for pairs of countries, allowing the error term to be heteroscedastic and correlated with specific country-to-country relations that we did not measure with the chosen variables.

Given this features, the first estimation results will provide a benchmark to compare the coefficients of the independent variables.

We expect, given the theoretical and empirical results of gravity literature and applied researches, positive values for economic size, adjacency, language and colonial relations, the last three being incentives to trade, on the other side a negative value for distance, the only trade cost.

### ***Gravity with EU dummy (1)***

We will begin our analysis running the estimation for the two sides of the trade flows involving Great Britain, namely import and export. We also included some additional variables:

- Free Trade Agreement (FTA);
- EU, a dummy for each member of the union.

#### FTA:

This is dummy associated with countries sharing a free trade agreement with Britain, we suppose the coefficient to be positive as having a free trade agreement should decrease the barriers to trade. It has to be mentioned that countries with FTA may very well not be randomly selected because reasons to make trade agreements may depend on already strong relations or such as geographical proximity. Said more generally there may be involved a specific subset of trading partners sharing some specific characteristics. Given that our aim consists in comparing the different integration levels arising from the estimated coefficients of the included dummy variables, it still makes sense to include FTA.

#### EU:

A dummy identifying all the members of the European Union based on their entrance date. This will be our basic gravity equation showing the first result for EU integration, even though general and not sector-specific.

#### Fixed effects:

Since we are interesting on the trade flow originating in one country or targeting only one country (Great Britain) country specific fixed effects will not be included.

We certainly expect a positive FTA, but mostly a strong, positive value for EU. More in depth, we expect the greatest magnitude for the coefficient concerning import, given that, as noticed in the stylized facts, Britain relies on EU more for import flows.

A very important point has to be made clear, in order to state the limits of this study: the reasons why EU magnitude is expected high certainly arise from membership of the Single Market, but the dummy also takes into account a range of possible other factors, which could be more important in defining its size. All other kinds of relationship GBR could have with EU members, even cultural, political, historical ties, economic freedom enjoyed in Europe etc.... The other fundamental cause for the magnitude and sign of the country coefficients may come from reasons of comparative advantage, and the degree of tariff and non-tariff barriers not controlled by our variables (for example trade regulations, quotas, more generally tariffs since distance only account for transport costs). Tariff barriers are of no concern since we are talking about the Single Market, but they affect trade with the other countries such as the USA and China. Comparative advantage as well as technical barriers, the latter to a less extent, instead, influence trade within the EU.

This could be not such a pressing issue since the goal of the analysis is to find how integrated is GBR with the EU countries by matter of fact, and not only by its common EU membership. Even though it is true that exiting the Union would make Britain lose only this particular effect, the level of trade and specifically integration, which has been determined since now by those factors will still be the basis for us to identify where the vulnerabilities lie.

### ***Gravity with EU, US and China (2)***

At the second step we add dummies for USA and China to compare the three coefficients thus the different levels of integration that Great Britain enjoys with these important partners which, a part from of the EU, represent the two biggest economies in the world by size and trade volume.

The expectations on these last two coefficients are uncertain, whether is true that they represent important shares of British trade, they are also big economies, a feature we account for in our control variables.

### ***Gravity with country dummies and year interaction term (3)***

Before going further on in analysing the trade integration at sectorial level, as a third step we want to have a look at the temporal evolution of the country dummies. We add a year interaction

term to compare the pattern of trade, whether it is improving and at which rate. We took inspiration from Schott (2008) and its work on product sophistication in China.

Firstly, we are sure to witness EU coefficients rising because of the entrance of new member states through the years. We also expect to see China rising but maybe exhibiting very low or even negative values in the initial years, meaning less than ‘normal’ trade for a country of its economic size: this because in the 90’s China benefitted from various economic reforms, started in the 70’s, as a change in industrial planning towards sector in which the country had a real comparative advantage, trade liberalizing reforms as the reduction of import and export licenses and quotas as well as currency regime changes<sup>8</sup> Another important factor: China entered WTO in 2001, so we expect sustained growth of trade integration from the beginning of the 2000’s. Among the three countries coefficients, the US ones should be the most stable, given that country relations with Great Britain were not subject to major modifications.

#### ***Sector-by-sector gravity (4)***

At this point the analysis takes one step back in terms of considering only the country dummies without the year interactive term, but goes further into analysing the components of the trade flows across the 97 sectors of trade: in this way it is possible to really identify where the most integrated level of trade happens.

Our expectations include finding the greatest part of EU coefficients positive and the import ones more specifically. We see more uncertainty with regards to the other two countries, with probably some significant sectors and a greater part (with respect to EU) of non significant or negative coefficients.

#### ***Sectorial level with country dummy and year interaction term (5)***

At last we run the regressions with the yearly interaction terms for some key sectors we found with the previous estimation results. This to further investigate the pattern of evolution of trade integration in some of the most important sectors of trade for Great Britain.

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<sup>8</sup> Lardi, N.R. (2003). *Trade liberalization and its role in Chinese economic growth*, Imf paper

## 5. Estimation results

### *Gravity at aggregated level (0)*

| Time-Industry Fixed Effects Regressions |                          |                          |
|-----------------------------------------|--------------------------|--------------------------|
|                                         | (1)                      | (2)                      |
| GDP EXPORT                              | 0.846 (***)<br>(0.007)   |                          |
| GDP IMPORT                              | 0.577 (***)<br>(0.007)   |                          |
| POPULATION EXPORT                       |                          | 0.872 (***)<br>(0.008)   |
| POPULATION IMPORT                       |                          | 0.570 (***)<br>(0.007)   |
| PCGDP EXPORT                            |                          | 0.803 (***)<br>(0.008)   |
| PCGDP IMPORT                            |                          | 0.592 (***)<br>(0.009)   |
| DISTANCE                                | -0.928 (***)<br>(0.018)  | -0.940 (***)<br>(0.018)  |
| ADJACENCY                               | 1.019 (***)<br>(0.083)   | 0.976 (***)<br>(0.085)   |
| LANGUAGE                                | 0.619 (***)<br>(0.045)   | 0.614 (***)<br>(0.046)   |
| COLONY                                  | 0.429 (***)<br>(0.074)   | 0.442 (***)<br>(0.075)   |
| CONSTANT                                | -17.287 (***)<br>(0.350) | -17.234 (***)<br>(0.350) |
| Number of observations                  | 9440880                  | 9436634                  |
| Adjusted R <sup>2</sup>                 | 0.2455                   | 0.2459                   |

Table 2. Gravity estimation with all exporter and importer countries<sup>9</sup>

The first estimation is run with GDP representing the economic size, the second one with population and per capita GDP of the countries. These variables have similar magnitude and are all significant, with the exporter countries elasticity being constantly higher: these is a sign of a potential home market effect. The so called ‘home market effect’ (Krugman 1980) theorizes that in the biggest and richest countries are concentrated the producer firms. In this way economic size will impact export in a greater way than it does to import.

<sup>9</sup> \*10%, \*\*5%, \*\*\*1% significance levels. The standard error is adjusted for 15,145 clusters in country pairs

Distance is almost perfectly elastic with the negative sign, as predicted by theory and the average results in empirical works<sup>10</sup>

Sharing a common border or a common language has a very strong positive impact, as well as historical colonial ties.

The coefficients overall are of about the same size across the two regressions.

### *Gravity with EU dummy (1)*

| Time-Industry Fixed Effects Regressions |                          |                          |                         |                         |
|-----------------------------------------|--------------------------|--------------------------|-------------------------|-------------------------|
|                                         | IMPORT                   |                          | EXPORT                  |                         |
|                                         | (1)                      | (2)                      | (3)                     | (4)                     |
| GDP EXPORT                              | 1.127 (***)<br>(0.037)   |                          |                         |                         |
| GDP IMPORT                              |                          |                          | 0.843 (***)<br>(0.024)  |                         |
| POPULATION EXPORT                       |                          | 1.141 (***)<br>(0.042)   |                         |                         |
| POPULATION IMPORT                       |                          |                          |                         | 0.803 (***)<br>(0.025)  |
| PCGDP EXPORT                            |                          | 1.087 (***)<br>(0.054)   |                         |                         |
| PCGDP IMPORT                            |                          |                          |                         | 0.974 (***)<br>(0.039)  |
| DISTANCE                                | -0.377 (***)<br>(0.147)  | -0.388 (***)<br>(0.148)  | -0.575 (***)<br>(0.082) | -0.550 (***)<br>(0.081) |
| ADJACENCY                               | 0.665 (**)<br>(0.324)    | 0.654 (**)<br>(0.319)    | 0.792 (***)<br>(0.213)  | 0.813 (***)<br>(0.217)  |
| LANGUAGE                                | 0.675 (**)<br>(0.323)    | 0.681 (**)<br>(0.322)    | 0.340 (*)<br>(0.180)    | 0.389 (**)<br>(0.162)   |
| COLONY                                  | 0.457<br>(0.318)         | 0.483<br>(0.318)         | 1.154 (***)<br>(0.172)  | 1.008 (***)<br>(0.157)  |
| FTA                                     | 0.583 (**)<br>(0.230)    | 0.623 (***)<br>(0.231)   | 0.452 (***)<br>(0.152)  | 0.308 (**)<br>(0.152)   |
| EU                                      | 1.901 (***)<br>(0.308)   | 1.971 (***)<br>(0.309)   | 1.131 (***)<br>(0.167)  | 0.879 (***)<br>(0.173)  |
| CONSTANT                                | -13.279 (***)<br>(1.561) | -13.106 (***)<br>(1.536) | -3.409 (***)<br>(0.997) | -3.994 (***)<br>(0.982) |
| Number of observations                  | 151701                   | 151701                   | 264024                  | 263834                  |
| Adjusted R <sup>2</sup>                 | 0.3526                   | 0.3532                   | 0.3658                  | 0.3667                  |

Table 3. Gravity estimations with Great Britain as the only importer or exporter country and EU dummy<sup>11</sup>

<sup>10</sup> See again Disdier and Head (2008)

<sup>11</sup> \*10%, \*\*5%, \*\*\*1% significance levels. The standard error is adjusted for 191 clusters in country pairs.

Table 3 shows that GDP is positive and significant with higher magnitude for exporters, similar to the general gravity.

Per capita GDP is positive and significant as well as population. The former is more important than population for the countries to which GBR exports whether they have more or less the same magnitude for countries from which it imports. In the general model population and PCGDP had more or less equal impact both for exports and imports: this may suggest that GBR export targets richer countries.

Distance is negative and significant even though far from the theoretical '-1'. Given that in the general gravity with all countries as importers and exporters simultaneously the elasticity was near the theoretically predicted one: this may suggest that GBR trade flows are less affected by distance related trade costs, specifically for what concerns British import.

The coefficient of contiguity is positive and significant.

Language is positive and significant.

Colony is positive but significant only for export.

The newly introduced dummy representing countries sharing free trade agreements is positive and significant for both import and export, even though less than half the size of EU dummy in all kinds of estimations.

Now we can focus on the variable of most interest to our analysis: EU is always positive and significant, with a higher impact for import. We notice that for export its magnitude is in line with Colony, meaning very strong exporting ties for Britain with its former colonies. This does not happen for import.

**Gravity with EU, US and China (2)**

| Time-Industry Fixed Effects Regressions |                          |                          |                         |                         |
|-----------------------------------------|--------------------------|--------------------------|-------------------------|-------------------------|
|                                         | IMPORT                   |                          | EXPORT                  |                         |
|                                         | (1)                      | (2)                      | (3)                     | (4)                     |
| GDP EXPORT                              | 1.115 (***)<br>(0.035)   |                          |                         |                         |
| GDP IMPORT                              |                          |                          | 0.851 (***)<br>(0.027)  |                         |
| POPULATION EXPORT                       |                          | 1.120 (***)<br>(0.038)   |                         |                         |
| POPULATION IMPORT                       |                          |                          |                         | 0.810 (***)<br>(0.027)  |
| PCGDP EXPORT                            |                          | 1.099 (***)<br>(0.057)   |                         |                         |
| PCGDP IMPORT                            |                          |                          |                         | 0.986 (***)<br>(0.040)  |
| DISTANCE                                | -0.406 (***)<br>(0.146)  | -0.410 (***)<br>(0.146)  | -0.583 (***)<br>(0.082) | -0.561 (***)<br>(0.081) |
| ADJACENCY                               | 0.539 (*)<br>(0.322)     | 0.538 (*)<br>(0.320)     | 0.764 (***)<br>(0.216)  | 0.772 (***)<br>(0.218)  |
| LANGUAGE                                | 0.723 (**)<br>(0.329)    | 0.724 (**)<br>(0.328)    | 0.361 (**)<br>(0.181)   | 0.416 (**)<br>(0.163)   |
| COLONY                                  | 0.508<br>(0.324)         | 0.517<br>(0.323)         | 1.160 (***)<br>(0.172)  | 1.015 (***)<br>(0.157)  |
| FTA                                     | 0.615 (***)<br>(0.223)   | 0.630 (***)<br>(0.228)   | 0.447 (***)<br>(0.154)  | 0.288 (*)<br>(0.153)    |
| EU                                      | 1.936 (***)<br>(0.304)   | 1.963 (***)<br>(0.311)   | 1.102 (***)<br>(0.171)  | 0.840 (***)<br>(0.174)  |
| USA                                     | -0.423<br>(0.277)        | -0.411<br>(0.283)        | -0.593 (***)<br>(0.239) | -0.740 (***)<br>(0.210) |
| CHN                                     | 1.786 (***)<br>(0.238)   | 1.753 (***)<br>(0.266)   | -0.029<br>(0.160)       | -0.212<br>(0.162)       |
| CONSTANT                                | -12.793 (***)<br>(1.468) | -12.733 (***)<br>(1.471) | -3.542 (***)<br>(1.037) | -4.114 (***)<br>(1.009) |
| Number of observations                  | 151701                   | 151701                   | 264024                  | 263834                  |
| Adjusted R <sup>2</sup>                 | 0.3552                   | 0.3554                   | 0.3655                  | 0.3664                  |

Table 4. Gravity estimations with Great Britain as the only importer or exporter country and EU, USA and China dummies<sup>12</sup>

With Table 4 we see that, while EU stays of the same magnitude and significance from the previous regressions, USA result not significant for import, and negative for export, CHN, on

<sup>12</sup> \*10%, \*\*5%, \*\*\*1% significance levels. The standard error is adjusted for 191 clusters in country pairs.

the other side is significant only for import, and positive in magnitude. For what concerns a comparison in size of the dummies, EU is always the largest, while US the lowest.

From this step we can assess that, as it was expected, trade flows with the other EU countries is the most important, not only for its size as reported in the stylized facts, but even in terms of better integration than with the two other big economies.

It is interesting to focus on the non-significant coefficient of the US in import and significantly negative one in export: this was unexpected given the share of trade this country represents for Great Britain. This is even more interesting if we see that on the other side, as expected, common language is significantly positive for both the directions of trade. Our guess is that this last dummy variable captures a range of features that Britain has in common with the English speaking countries which constitute a very strong incentive to trade, like cultural affinities, the use of a Common Law legal system and of course language. In other words we are controlling for more variables, and very relevant ones, in the case of bilateral flows USA-Great Britain than in those involving the other two economies, China and the EU, resulting in deflated magnitude for the USA dummy.

**Gravity with country dummies and year interaction term (3)**

| Time-Industry Fixed Effects Regressions with Country-Year Interactive Terms |                                   |                                   |        |                                    |                                    |        |                                   |                                    |
|-----------------------------------------------------------------------------|-----------------------------------|-----------------------------------|--------|------------------------------------|------------------------------------|--------|-----------------------------------|------------------------------------|
| IMPORT                                                                      |                                   | EXPORT                            | IMPORT |                                    | EXPORT                             | IMPORT |                                   | EXPORT                             |
| (1)                                                                         |                                   | (2)                               | (1)    |                                    | (2)                                | (1)    |                                   | (2)                                |
| EU93                                                                        | 1.110 <sup>(***)</sup><br>(0.372) | 0.368<br>(0.450)                  | USA93  | -1.300 <sup>(***)</sup><br>(0.276) | -1.291 <sup>(***)</sup><br>(0.216) | CHN93  | 0.813 <sup>(***)</sup><br>(0.273) | -0.790 <sup>(***)</sup><br>(0.170) |
| EU94                                                                        | 1.097 <sup>(***)</sup><br>(0.348) | 0.797 <sup>(***)</sup><br>(0.199) | USA94  | -1.351 <sup>(***)</sup><br>(0.270) | -1.229 <sup>(***)</sup><br>(0.216) | CHN94  | 0.833 <sup>(***)</sup><br>(0.271) | -0.461 <sup>(***)</sup><br>(0.168) |
| EU95                                                                        | 1.110 <sup>(***)</sup><br>(0.314) | 0.705 <sup>(***)</sup><br>(0.208) | USA95  | -1.131 <sup>(***)</sup><br>(0.279) | -1.124 <sup>(***)</sup><br>(0.214) | CHN95  | 0.734 <sup>(***)</sup><br>(0.226) | -0.475 <sup>(***)</sup><br>(0.166) |
| EU96                                                                        | 1.229 <sup>(***)</sup><br>(0.324) | 0.736 <sup>(***)</sup><br>(0.203) | USA96  | -1.022 <sup>(***)</sup><br>(0.287) | -1.103 <sup>(***)</sup><br>(0.214) | CHN96  | 0.771 <sup>(***)</sup><br>(0.264) | -0.629 <sup>(***)</sup><br>(0.165) |
| EU97                                                                        | 1.428 <sup>(***)</sup><br>(0.321) | 0.766 <sup>(***)</sup><br>(0.203) | USA97  | -0.949 <sup>(***)</sup><br>(0.288) | -1.100 <sup>(***)</sup><br>(0.215) | CHN97  | 0.780 <sup>(***)</sup><br>(0.270) | -0.474 <sup>(***)</sup><br>(0.163) |
| EU98                                                                        | 1.359 <sup>(***)</sup><br>(0.322) | 0.737 <sup>(***)</sup><br>(0.204) | USA98  | -0.997 <sup>(***)</sup><br>(0.295) | -1.023 <sup>(***)</sup><br>(0.216) | CHN98  | 1.096 <sup>(***)</sup><br>(0.272) | -0.269<br>(0.164)                  |
| EU99                                                                        | 1.280 <sup>(***)</sup><br>(0.305) | 0.592 <sup>(**)</sup><br>(0.229)  | USA99  | -1.168 <sup>(***)</sup><br>(0.296) | -1.004 <sup>(***)</sup><br>(0.221) | CHN99  | 0.771 <sup>(***)</sup><br>(0.271) | 0.014<br>(0.166)                   |
| EU00                                                                        | 1.677 <sup>(***)</sup><br>(0.337) | 0.776 <sup>(***)</sup><br>(0.231) | USA00  | -0.771 <sup>(**)</sup><br>(0.306)  | -0.867 <sup>(***)</sup><br>(0.220) | CHN00  | 1.359 <sup>(***)</sup><br>(0.283) | 0.102<br>(0.166)                   |
| EU01                                                                        | 1.635 <sup>(***)</sup><br>(0.335) | 0.754 <sup>(***)</sup><br>(0.225) | USA01  | -0.831 <sup>(***)</sup><br>(0.312) | -0.935 <sup>(***)</sup><br>(0.224) | CHN01  | 1.284 <sup>(***)</sup><br>(0.281) | -0.185<br>(0.166)                  |
| EU02                                                                        | 1.719 <sup>(***)</sup><br>(0.336) | 0.751 <sup>(***)</sup><br>(0.236) | USA02  | -0.880 <sup>(***)</sup><br>(0.309) | -0.912 <sup>(***)</sup><br>(0.221) | CHN02  | 1.436 <sup>(***)</sup><br>(0.280) | 0.150<br>(0.163)                   |
| EU03                                                                        | 1.779 <sup>(***)</sup><br>(0.338) | 0.656 <sup>(***)</sup><br>(0.216) | USA03  | -0.718 <sup>(**)</sup><br>(0.304)  | -0.813 <sup>(***)</sup><br>(0.219) | CHN03  | 1.514 <sup>(***)</sup><br>(0.280) | 0.503 <sup>(***)</sup><br>(0.164)  |
| EU04                                                                        | 1.777 <sup>(***)</sup><br>(0.311) | 0.584 <sup>(***)</sup><br>(0.179) | USA04  | -0.475<br>(0.307)                  | -0.758 <sup>(***)</sup><br>(0.217) | CHN04  | 2.182 <sup>(***)</sup><br>(0.280) | 0.512 <sup>(***)</sup><br>(0.165)  |
| EU05                                                                        | 1.996 <sup>(***)</sup><br>(0.302) | 0.678 <sup>(***)</sup><br>(0.187) | USA05  | -0.338<br>(0.298)                  | -0.698 <sup>(***)</sup><br>(0.216) | CHN05  | 2.287 <sup>(***)</sup><br>(0.277) | 0.607 <sup>(***)</sup><br>(0.163)  |
| EU06                                                                        | 2.173 <sup>(***)</sup><br>(0.318) | 0.812 <sup>(***)</sup><br>(0.190) | USA06  | -0.103<br>(0.310)                  | -0.578 <sup>(***)</sup><br>(0.214) | CHN06  | 2.586 <sup>(***)</sup><br>(0.283) | 0.622 <sup>(***)</sup><br>(0.162)  |
| EU07                                                                        | 2.123 <sup>(***)</sup><br>(0.311) | 0.867 <sup>(***)</sup><br>(0.184) | USA07  | -0.086<br>(0.296)                  | -0.459 <sup>(**)</sup><br>(0.210)  | CHN07  | 2.477 <sup>(***)</sup><br>(0.276) | 0.669 <sup>(***)</sup><br>(0.162)  |
| EU08                                                                        | 2.142 <sup>(***)</sup><br>(0.318) | 0.887 <sup>(***)</sup><br>(0.184) | USA08  | -0.006<br>(0.298)                  | -0.447 <sup>(**)</sup><br>(0.209)  | CHN08  | 2.478 <sup>(***)</sup><br>(0.285) | 0.561 <sup>(***)</sup><br>(0.166)  |
| EU09                                                                        | 2.165 <sup>(***)</sup><br>(0.312) | 0.865 <sup>(***)</sup><br>(0.191) | USA09  | -0.002<br>(0.297)                  | -0.622 <sup>(***)</sup><br>(0.212) | CHN09  | 2.186 <sup>(***)</sup><br>(0.282) | 0.561 <sup>(***)</sup><br>(0.169)  |
| EU10                                                                        | 2.423 <sup>(***)</sup><br>(0.305) | 1.050 <sup>(***)</sup><br>(0.182) | USA10  | 0.230<br>(0.291)                   | -0.462 <sup>(**)</sup><br>(0.211)  | CHN10  | 2.342 <sup>(***)</sup><br>(0.246) | 0.547 <sup>(***)</sup><br>(0.170)  |
| EU11                                                                        | 2.528 <sup>(***)</sup><br>(0.310) | 1.034 <sup>(***)</sup><br>(0.182) | USA11  | 0.332<br>(0.295)                   | -0.415 <sup>(**)</sup><br>(0.208)  | CHN11  | 2.521 <sup>(***)</sup><br>(0.292) | 0.729 <sup>(***)</sup><br>(0.171)  |
| EU12                                                                        | 2.567 <sup>(***)</sup><br>(0.320) | 1.024 <sup>(***)</sup><br>(0.174) | USA12  | 0.337<br>(0.290)                   | -0.338<br>(0.208)                  | CHN12  | 2.286 <sup>(***)</sup><br>(0.285) | 0.520 <sup>(***)</sup><br>(0.171)  |
| EU13                                                                        | 2.586 <sup>(***)</sup><br>(0.328) | 1.088 <sup>(***)</sup><br>(0.174) | USA13  | 0.268<br>(0.301)                   | -0.289<br>(0.210)                  | CHN13  | 2.391 <sup>(***)</sup><br>(0.290) | 0.659 <sup>(***)</sup><br>(0.174)  |
| EU14                                                                        | 2.686 <sup>(***)</sup><br>(0.321) | 1.156 <sup>(***)</sup><br>(0.182) | USA14  | 0.324<br>(0.295)                   | -0.213<br>(0.212)                  | CHN14  | 2.241 <sup>(***)</sup><br>(0.292) | 0.725 <sup>(***)</sup><br>(0.177)  |

Table 5. Gravity estimate with year interaction terms: table of countries coefficients<sup>13</sup>

<sup>13</sup> \*10%, \*\*5%, \*\*\*1% significance levels. The standard error is adjusted for 191 clusters in country pairs.

In order to see this evolution pattern of trade integration, the countries dummies have been interacted with the year variable and the results showed in Table 5,6 and 7. In this analysis we kept only per capita GDP and population as the variables representing economic size of the countries.

We notice that all the countries, at least to a certain extent, exhibit a pattern of increased size of the coefficient, both for import and for export.

The explanatory variables in common remain constant across all this different steps.

The EU values, always positive, grow at a compound annual growth rate<sup>14</sup> (CAGR) of 4.2% for import and 1.8% for export.

The Chinese coefficients exhibit an even stronger trend, with 4.9% and 3.3%. For export the growth is computed since the first positive number, in year 2003, and it is even more impressive considering the negative start of the first five years.

The US ones cannot be computed by CAGR (given the negative signs) however we can see, for both import and export, a trend of recovery from less than expected trade to normal levels.

These results show even though there was a general pattern of increased trade, British flows were not symmetrically affected by it for all of its partners.

Something we cannot say is whether this improved trade integration is due to intensive or extensive margin growth, the former implying a growth of the volume of trade by the same industries, the latter by the commercialization of new products. Indeed, we would have needed data at a higher digits level to investigate this phenomenon. The literature divides, with for example Hummels and Klenow (2005) and Helpman, Melitz and Rubinstein (2008) supporting the theory of extensive margin growth whether Besedeš and Prusa (2007) find evidence for intensive margin growth.

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<sup>14</sup> The CAGR represents the mean annual growth rate, usually used in finance. The Italian stock exchange defines it as:  
$$CARG = [(X_n/X_0)^{1/n}] - 1$$

### ***Sector-by-sector gravity (4)***

We obtained the coefficient for import and export as well as the averages between the two values for each of the twenty-one sections in which the HS two-digits nomenclature divides the trade goods sectors: tables for each hs2 category and country are included in the appendix.

In table 6 we provide for some description of the coefficient sign and significance:

| Country | IMPORT   |          |      | EXPORT   |          |      |
|---------|----------|----------|------|----------|----------|------|
|         | positive | negative | n.s. | positive | negative | n.s. |
| EU      | 60       | 1        | 36   | 66       | 3        | 28   |
| USA     | 8        | 27       | 62   | 11       | 46       | 40   |
| China   | 62       | 7        | 28   | 32       | 20       | 47   |

*Table 6. General features of countries coefficients*

If we look at the EU coefficients, we notice that they are positive and significant for most of the sectors both for import.

For import, the maximum value is reached in textile sector 61: “Articles of apparel and clothing accessories, knitted or crocheted”. For export, the maximum is displayed in another textile sector, number 60: “Knitted or crocheted fabrics”.

For import the coefficients are negative only in sector 81: “Other base metals; cermets; articles thereof”.

The cases in which the US coefficients are positive and significant are the least among the three country dummies, with only eight positive sectors for import and eleven for export. What’s more, here we witness the most of the negative sectors.

As the last country, the Chinese positive coefficients are even more than the EU ones for import, and still a consistent part for export.

### **EU sectorial integration:**

It was well expected that the great majority of EU coefficients were positive and of high magnitude, this because of the EU membership and all the uncontrolled variables (all the reasons we talked about for the general EU dummy here applies). A common feature across them is that for import they are higher than for export: this represents more intense import trade flows with the EU compared to the rest of the world with respect to the export ones. These

feature stands true also for China: the two economies are more integrated to Great Britain as import partners.

Among the few negative coefficients in export there is sector 88, this happens despite it represents an important share of British export. This means Britain trades most of these goods with extra-EU countries<sup>15</sup>. Some of these countries are exactly the USA and China only in the case of ‘works of art and antiques’ (97).

Concerning the import trade flow, there is still only one case in which the EU coefficients is negative and the other two country dummies show a positive one, it happens with sector 81.

Even though it represents the highest share of export, machinery and mechanical appliances (84) has a positive value only in import, while another key industry, electrical machinery (85), with 0.65 has a positive but lower magnitude than the average of the EU (0.84). Organic chemicals (29) and mineral fuels (27), on the other hand, target the EU market more intensively, as we can see from their coefficients of 1.35 and 1.8.

If we consider the average level of integration, the textile section, concerning sectors from number 50 to 63, exhibits the highest integration. Vehicles (87) and pharmaceutical products (30) which we highlighted for their strategic importance (both for the size and position in the European value chain) result very highly integrated with EU: the automotive industry is the most integrated and the pharmaceutical one ranks eighth. Their import coefficients are far higher than the general European one of 1.96, evidencing respectively 4.19 and 3.69. Sector 87 results also very integrated in export, with 1.45, while 30 is in line with the European one, with 0.78.

#### Tariff barriers:

Having all the coefficients, we can integrate our analysis taking WTO tariffs data at MFN level for as reported by the EU in order to assess which sectors of trade would be the most affected in export towards Europe. All tariff data is included in the appendix.

The highest tariffs apply to the textile section, where values average between 2.8% and 11.7%: the highest one belongs to sector 61, which was also the most integrated in import and ranking second on average.

There are a number of categories for which the MFN tariff applied is zero, among them sectors concerning the paper industry, 48 and 49, which also display a high integration with values above the average both for import and for export.

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<sup>15</sup> Always taking into account the control variables

The most important sectors for share are linked with very different possible tariff levels from the plastic industry (39), with the highest value of 6% to sector 30, with the lowest level of zero. Sector 87, the most important one in 2014, exhibits the second highest average tariff level among these top goods, 5.8%. Sector 29 would suffer from average tariffs of 4.3%, and also the industries categorized with 84 and 85, would face average barriers as 1.8% and 2.8%. Sector 27 would suffer less with average tariffs of 0.8%. This, combined to the the share of these products on export, make easy to forecast a very large potential financial loss.

### ***Sectorial level with country dummy and year interaction term (5)***

We choose the highest coefficient for EU integration together with the importance for British trade in order to identify the sectors to analyse further: in this way we select sector 87 and 30.

#### ***Hs2 Sector 87***

It represents “Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof”.

With an import coefficient of 4.19 and an export coefficient of 1.45 it averages 2.82, being in this way the most integrated sector of British trade with EU. What’s more, this is also a strategic sector for Great Britain as we can see for its weight in the trade shares, as we can see from Figure 6 and Figure 7.



Figure 8. Import share for hs2 87



Figure 9. Export share for hs2 87

**Time-Industry Fixed Effects Regressions with Country-Year Interactive Terms (Sector 87)**

| IMPORT |                                 | EXPORT                          |       | IMPORT                           |                                  | EXPORT |                                 | IMPORT                           |  | EXPORT |     |
|--------|---------------------------------|---------------------------------|-------|----------------------------------|----------------------------------|--------|---------------------------------|----------------------------------|--|--------|-----|
|        | (1)                             | (2)                             |       | (1)                              | (2)                              |        | (1)                             | (2)                              |  | (1)    | (2) |
| EU93   | 2.697 <sup>***</sup><br>(0.955) | 0.885 <sup>***</sup><br>(0.557) | USA93 | -1.815 <sup>**</sup><br>(0.716)  | -1.889 <sup>***</sup><br>(0.340) | CHN93  | 1.357 <sup>**</sup><br>(0.620)  | -0.783 <sup>***</sup><br>(0.271) |  |        |     |
| EU94   | 2.739 <sup>***</sup><br>(0.940) | 1.309 <sup>***</sup><br>(0.304) | USA94 | -1.373 <sup>*</sup><br>(0.712)   | -1.588 <sup>***</sup><br>(0.340) | CHN94  | 1.415 <sup>**</sup><br>(0.622)  | -1.943 <sup>***</sup><br>(0.257) |  |        |     |
| EU95   | 2.978 <sup>***</sup><br>(0.854) | 1.137 <sup>***</sup><br>(0.313) | USA95 | -1.557 <sup>**</sup><br>(0.697)  | -1.616 <sup>***</sup><br>(0.339) | CHN95  | 0.695 <sup>***</sup><br>(0.605) | -2.249 <sup>***</sup><br>(0.249) |  |        |     |
| EU96   | 3.646 <sup>***</sup><br>(0.854) | 1.173 <sup>***</sup><br>(0.301) | USA96 | -1.118 <sup>***</sup><br>(0.724) | -1.673 <sup>***</sup><br>(0.336) | CHN96  | 0.820 <sup>***</sup><br>(0.645) | -2.386 <sup>***</sup><br>(0.235) |  |        |     |
| EU97   | 3.880 <sup>***</sup><br>(0.922) | 1.218 <sup>***</sup><br>(0.294) | USA97 | -1.005 <sup>***</sup><br>(0.744) | -1.672 <sup>***</sup><br>(0.333) | CHN97  | 0.904 <sup>***</sup><br>(0.659) | -2.288 <sup>***</sup><br>(0.236) |  |        |     |
| EU98   | 3.898 <sup>***</sup><br>(0.896) | 1.437 <sup>***</sup><br>(0.287) | USA98 | -0.835 <sup>***</sup><br>(0.728) | -1.461 <sup>***</sup><br>(0.335) | CHN98  | 1.326 <sup>**</sup><br>(0.623)  | -1.772 <sup>***</sup><br>(0.238) |  |        |     |
| EU99   | 3.509 <sup>***</sup><br>(0.873) | 1.513 <sup>**</sup><br>(0.305)  | USA99 | -1.029 <sup>***</sup><br>(0.760) | -1.236 <sup>***</sup><br>(0.336) | CHN99  | 1.047 <sup>***</sup><br>(0.643) | -1.742 <sup>***</sup><br>(0.244) |  |        |     |
| EU00   | 3.773 <sup>***</sup><br>(0.872) | 1.872 <sup>***</sup><br>(0.296) | USA00 | -1.136 <sup>***</sup><br>(0.730) | -0.847 <sup>**</sup><br>(0.336)  | CHN00  | 1.383 <sup>**</sup><br>(0.637)  | -1.983 <sup>***</sup><br>(0.248) |  |        |     |
| EU01   | 3.790 <sup>***</sup><br>(0.894) | 1.581 <sup>***</sup><br>(0.304) | USA01 | -1.025 <sup>***</sup><br>(0.735) | -1.025 <sup>***</sup><br>(0.339) | CHN01  | 1.277 <sup>**</sup><br>(0.626)  | -1.768 <sup>***</sup><br>(0.248) |  |        |     |
| EU02   | 4.045 <sup>***</sup><br>(0.910) | 1.733 <sup>***</sup><br>(0.304) | USA02 | -0.910 <sup>***</sup><br>(0.773) | -0.368 <sup>***</sup><br>(0.341) | CHN02  | 1.716 <sup>**</sup><br>(0.666)  | -1.758 <sup>***</sup><br>(0.242) |  |        |     |
| EU03   | 3.685 <sup>***</sup><br>(0.915) | 1.572 <sup>***</sup><br>(0.314) | USA03 | -0.877 <sup>***</sup><br>(0.775) | -0.358 <sup>***</sup><br>(0.358) | CHN03  | 1.812 <sup>***</sup><br>(0.663) | -0.788 <sup>***</sup><br>(0.244) |  |        |     |
| EU04   | 4.327 <sup>***</sup><br>(0.714) | 1.526 <sup>***</sup><br>(0.282) | USA04 | -0.462 <sup>***</sup><br>(0.746) | -0.348 <sup>***</sup><br>(0.332) | CHN04  | 2.528 <sup>***</sup><br>(0.683) | -0.448 <sup>*</sup><br>(0.243)   |  |        |     |
| EU05   | 4.147 <sup>***</sup><br>(0.744) | 1.716 <sup>***</sup><br>(0.294) | USA05 | -0.705 <sup>***</sup><br>(0.743) | -0.127 <sup>***</sup><br>(0.330) | CHN05  | 2.383 <sup>***</sup><br>(0.673) | -0.072 <sup>***</sup><br>(0.241) |  |        |     |
| EU06   | 4.390 <sup>***</sup><br>(0.737) | 1.575 <sup>***</sup><br>(0.289) | USA06 | -0.468 <sup>***</sup><br>(0.715) | -0.363 <sup>***</sup><br>(0.363) | CHN06  | 2.402 <sup>***</sup><br>(0.666) | -0.200 <sup>***</sup><br>(0.234) |  |        |     |
| EU07   | 4.387 <sup>***</sup><br>(0.702) | 1.840 <sup>***</sup><br>(0.286) | USA07 | -0.205 <sup>***</sup><br>(0.723) | -0.594 <sup>*</sup><br>(0.319)   | CHN07  | 2.749 <sup>***</sup><br>(0.671) | 0.520 <sup>**</sup><br>(0.236)   |  |        |     |
| EU08   | 4.243 <sup>***</sup><br>(0.756) | 1.609 <sup>***</sup><br>(0.273) | USA08 | -0.131 <sup>***</sup><br>(0.746) | -0.656 <sup>*</sup><br>(0.313)   | CHN08  | 2.639 <sup>***</sup><br>(0.696) | 0.682 <sup>***</sup><br>(0.237)  |  |        |     |
| EU09   | 4.379 <sup>***</sup><br>(0.752) | 1.550 <sup>***</sup><br>(0.272) | USA09 | -0.050 <sup>***</sup><br>(0.710) | -0.584 <sup>*</sup><br>(0.318)   | CHN09  | 2.490 <sup>***</sup><br>(0.670) | 0.961 <sup>***</sup><br>(0.245)  |  |        |     |
| EU10   | 4.703 <sup>***</sup><br>(0.741) | 1.410 <sup>***</sup><br>(0.263) | USA10 | 0.307 <sup>***</sup><br>(0.733)  | -0.665 <sup>*</sup><br>(0.316)   | CHN10  | 2.742 <sup>***</sup><br>(0.706) | 1.390 <sup>***</sup><br>(0.248)  |  |        |     |
| EU11   | 4.680 <sup>***</sup><br>(0.750) | 1.434 <sup>***</sup><br>(0.251) | USA11 | 0.415 <sup>***</sup><br>(0.708)  | -0.818 <sup>**</sup><br>(0.315)  | CHN11  | 2.602 <sup>***</sup><br>(0.713) | 1.437 <sup>***</sup><br>(0.249)  |  |        |     |
| EU12   | 4.868 <sup>***</sup><br>(0.744) | 1.269 <sup>***</sup><br>(0.247) | USA12 | 0.465 <sup>***</sup><br>(0.732)  | -0.762 <sup>**</sup><br>(0.316)  | CHN12  | 2.574 <sup>***</sup><br>(0.726) | 1.643 <sup>***</sup><br>(0.245)  |  |        |     |
| EU13   | 4.636 <sup>***</sup><br>(0.705) | 1.142 <sup>***</sup><br>(0.246) | USA13 | 0.198 <sup>***</sup><br>(0.669)  | -0.789 <sup>**</sup><br>(0.320)  | CHN13  | 2.249 <sup>***</sup><br>(0.723) | 1.735 <sup>***</sup><br>(0.251)  |  |        |     |
| EU14   | 4.785 <sup>***</sup><br>(0.734) | 1.346 <sup>***</sup><br>(0.269) | USA14 | 0.467 <sup>***</sup><br>(0.716)  | -0.695 <sup>**</sup><br>(0.324)  | CHN14  | 2.399 <sup>***</sup><br>(0.708) | 1.996 <sup>***</sup><br>(0.254)  |  |        |     |

Table 7. Gravity estimate at sector 87 level with year interaction terms: table of countries coefficients<sup>16</sup>

<sup>16</sup> \*10%, \*\*5%, \*\*\*1% significance levels. The standard error is adjusted for 191 clusters in country pairs.

From the coefficients in Table 9 and Table 10 we see that the evolution of trade integration with the EU is not only high but also grows at the fastest pace, at an annual rate of 2.7% (import), tied with China, and 0.1% (export). The eastern country becomes a very important export market, with a growth of 21% in the last eight years and starting from negative levels. This happens notwithstanding the high tariffs (16%), especially compared to the US ones (3.4%). The USA is not positively integrated in both directions of trade, even though we witness a partial recovery for export.

The tariff levels for the European Union are extremely important, since they average 5.8%, and even reach 10% for finished vehicles, meaning the country would be hit very hard trading with the EU at WTO regime.

#### *Hs 2 Sector 30*

In this category are included pharmaceutical products. The import coefficient of 3.69 and the export one of 0.78 give an average value of 2.23, setting it eighth in ranking.

This is another strategic sector for Britain, for its relative weight, as it was for sector 87, but also for a visible pattern of growth which may cover further potential in the future (see Figure 8 and Figure 9). This was first noticed in the stylized facts and here made more visible.

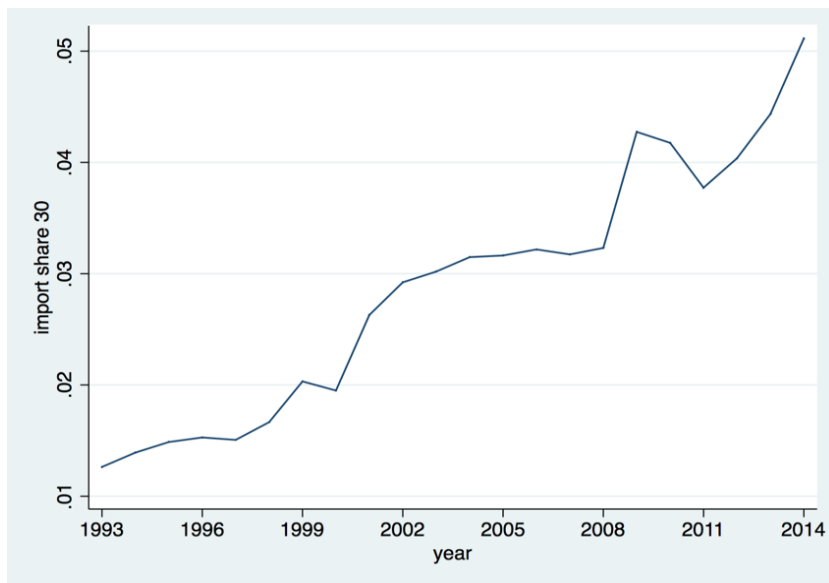


Figure 10. Import share for hs2 30



Figure 11. Export share for hs2 30

Time-Industry Fixed Effects Regressions with Country-Year Interactive Terms (Sector 30)

| IMPORT |                                   | EXPORT                            |       | IMPORT                             |                                    | EXPORT |                                   | IMPORT                             |  | EXPORT |     |
|--------|-----------------------------------|-----------------------------------|-------|------------------------------------|------------------------------------|--------|-----------------------------------|------------------------------------|--|--------|-----|
|        | (1)                               | (2)                               |       | (1)                                | (2)                                |        | (1)                               | (2)                                |  | (1)    | (2) |
| EU93   | 1.793 <sup>(**)</sup><br>(0.721)  | -0.432<br>(0.710)                 | USA93 | -2.840 <sup>(***)</sup><br>(0.746) | -2.772 <sup>(***)</sup><br>(0.306) | CHN93  | 2.381 <sup>(***)</sup><br>(0.672) | -2.655 <sup>(***)</sup><br>(0.250) |  |        |     |
| EU94   | 1.870 <sup>(***)</sup><br>(0.707) | 0.017<br>(0.348)                  | USA94 | -2.409 <sup>(***)</sup><br>(0.782) | -2.878 <sup>(***)</sup><br>(0.305) | CHN94  | 2.275 <sup>(***)</sup><br>(0.708) | -2.455 <sup>(***)</sup><br>(0.245) |  |        |     |
| EU95   | 2.338 <sup>(***)</sup><br>(0.675) | 0.051<br>(0.332)                  | USA95 | -2.047 <sup>(***)</sup><br>(0.735) | -2.502 <sup>(***)</sup><br>(0.300) | CHN95  | 2.390 <sup>(***)</sup><br>(0.684) | -1.909 <sup>(***)</sup><br>(0.242) |  |        |     |
| EU96   | 2.759 <sup>(***)</sup><br>(0.730) | 0.317<br>(0.325)                  | USA96 | -1.311 <sup>(*)</sup><br>(0.735)   | -2.485 <sup>(***)</sup><br>(0.300) | CHN96  | 2.171 <sup>(***)</sup><br>(0.634) | -1.511 <sup>(***)</sup><br>(0.243) |  |        |     |
| EU97   | 2.569 <sup>(***)</sup><br>(0.661) | 0.099<br>(0.329)                  | USA97 | -1.747 <sup>(**)</sup><br>(0.735)  | -2.733 <sup>(***)</sup><br>(0.303) | CHN97  | 2.166 <sup>(***)</sup><br>(0.620) | -2.558 <sup>(***)</sup><br>(0.244) |  |        |     |
| EU98   | 2.880 <sup>(***)</sup><br>(0.697) | 0.193<br>(0.337)                  | USA98 | -1.607 <sup>(**)</sup><br>(0.738)  | -2.563 <sup>(***)</sup><br>(0.311) | CHN98  | 2.564 <sup>(***)</sup><br>(0.617) | -2.143 <sup>(***)</sup><br>(0.252) |  |        |     |
| EU99   | 3.005 <sup>(***)</sup><br>(0.707) | -0.076<br>(0.358)                 | USA99 | -1.414 <sup>(*)</sup><br>(0.765)   | -2.521 <sup>(***)</sup><br>(0.309) | CHN99  | 1.846 <sup>(***)</sup><br>(0.644) | -1.541 <sup>(***)</sup><br>(0.246) |  |        |     |
| EU00   | 3.449 <sup>(***)</sup><br>(0.732) | 0.397<br>(0.344)                  | USA00 | -0.932<br>(0.753)                  | -2.158 <sup>(***)</sup><br>(0.308) | CHN00  | 2.175 <sup>(***)</sup><br>(0.575) | -0.132<br>(0.243)                  |  |        |     |
| EU01   | 2.681 <sup>(***)</sup><br>(0.902) | 0.546<br>(0.338)                  | USA01 | -0.602<br>(0.751)                  | -2.118 <sup>(***)</sup><br>(0.316) | CHN01  | 1.807 <sup>(***)</sup><br>(0.585) | -0.231<br>(0.256)                  |  |        |     |
| EU02   | 3.514 <sup>(***)</sup><br>(0.756) | 0.498<br>(0.402)                  | USA02 | -0.893<br>(0.789)                  | -1.824 <sup>(***)</sup><br>(0.314) | CHN02  | 1.875 <sup>(***)</sup><br>(0.588) | -0.658 <sup>(**)</sup><br>(0.257)  |  |        |     |
| EU03   | 2.751 <sup>(***)</sup><br>(0.736) | 0.800 <sup>(**)</sup><br>(0.325)  | USA03 | -1.182<br>(0.744)                  | -1.427 <sup>(***)</sup><br>(0.303) | CHN03  | 1.627 <sup>(***)</sup><br>(0.583) | -0.057<br>(0.245)                  |  |        |     |
| EU04   | 2.695 <sup>(***)</sup><br>(0.767) | 0.898 <sup>(***)</sup><br>(0.287) | USA04 | -0.560<br>(0.776)                  | -1.350 <sup>(***)</sup><br>(0.299) | CHN04  | 2.058 <sup>(***)</sup><br>(0.579) | -0.039<br>(0.247)                  |  |        |     |
| EU05   | 3.322 <sup>(***)</sup><br>(0.736) | 0.711 <sup>(**)</sup><br>(0.308)  | USA05 | 0.003<br>(0.781)                   | -1.469 <sup>(***)</sup><br>(0.305) | CHN05  | 2.904 <sup>(***)</sup><br>(0.594) | -0.150<br>(0.256)                  |  |        |     |
| EU06   | 3.448 <sup>(***)</sup><br>(0.730) | 0.826 <sup>(***)</sup><br>(0.307) | USA06 | 0.595<br>(0.748)                   | -1.332 <sup>(***)</sup><br>(0.298) | CHN06  | 3.278 <sup>(***)</sup><br>(0.573) | -0.207<br>(0.246)                  |  |        |     |
| EU07   | 3.977 <sup>(***)</sup><br>(0.731) | 0.819 <sup>(***)</sup><br>(0.308) | USA07 | 1.066<br>(0.796)                   | -0.944 <sup>(***)</sup><br>(0.287) | CHN07  | 3.600 <sup>(***)</sup><br>(0.622) | 0.174<br>(0.247)                   |  |        |     |
| EU08   | 3.668 <sup>(***)</sup><br>(0.709) | 0.928 <sup>(***)</sup><br>(0.333) | USA08 | 1.021<br>(0.763)                   | -0.744 <sup>(***)</sup><br>(0.284) | CHN08  | 3.368 <sup>(***)</sup><br>(0.609) | 0.395<br>(0.244)                   |  |        |     |
| EU09   | 4.017 <sup>(***)</sup><br>(0.730) | 1.066 <sup>(***)</sup><br>(0.324) | USA09 | 1.002<br>(0.798)                   | -0.700 <sup>(**)</sup><br>(0.297)  | CHN09  | 3.067 <sup>(***)</sup><br>(0.617) | 0.476 <sup>(*)</sup><br>(0.254)    |  |        |     |
| EU10   | 4.411 <sup>(***)</sup><br>(0.702) | 1.267 <sup>(***)</sup><br>(0.311) | USA10 | 1.100<br>(0.765)                   | -0.507 <sup>(*)</sup><br>(0.303)   | CHN10  | 3.318 <sup>(***)</sup><br>(0.587) | 0.542 <sup>(**)</sup><br>(0.264)   |  |        |     |
| EU11   | 4.605 <sup>(***)</sup><br>(0.724) | 1.223 <sup>(***)</sup><br>(0.329) | USA11 | 1.449 <sup>(*)</sup><br>(0.766)    | -0.569 <sup>(*)</sup><br>(0.297)   | CHN11  | 3.543 <sup>(***)</sup><br>(0.602) | 0.801 <sup>(***)</sup><br>(0.265)  |  |        |     |
| EU12   | 5.168 <sup>(***)</sup><br>(0.758) | 1.373 <sup>(***)</sup><br>(0.300) | USA12 | 1.617 <sup>(**)</sup><br>(0.816)   | -0.650 <sup>(**)</sup><br>(0.297)  | CHN12  | 3.846 <sup>(***)</sup><br>(0.630) | 0.759 <sup>(***)</sup><br>(0.262)  |  |        |     |
| EU13   | 5.130 <sup>(***)</sup><br>(0.731) | 1.186 <sup>(***)</sup><br>(0.302) | USA13 | 0.997<br>(0.802)                   | -0.780 <sup>(***)</sup><br>(0.291) | CHN13  | 3.665 <sup>(***)</sup><br>(0.606) | 0.685 <sup>(***)</sup><br>(0.262)  |  |        |     |
| EU14   | 5.448 <sup>(***)</sup><br>(0.754) | 1.344 <sup>(***)</sup><br>(0.312) | USA14 | 1.117<br>(0.811)                   | -0.620 <sup>(**)</sup><br>(0.300)  | CHN14  | 3.753 <sup>(***)</sup><br>(0.644) | 0.728 <sup>(***)</sup><br>(0.268)  |  |        |     |

Table 8. Gravity estimate at sector 87 level with year interaction terms: table of countries coefficients<sup>17</sup>

<sup>17</sup> \*10%, \*\*5%, \*\*\*1% significance levels. The standard error is adjusted for 191 clusters in country pairs.

Looking at the tables, the EU result the most important market for this good and its relevance grows at a very fast rate 5.4% for import and 4.8% for export. China becomes very important, too, with a 2.1% growth for import and recovering from very low levels until reaching positive values from 2009 in export. The US do not show positive levels of integration even though export improved, starting from levels very similar to those of China.

It is important to remark that this sector is not subject to potential harmful tariff barrier from the EU (0%), however we have to keep in mind that exiting the union will come with the cost of not influencing the new regulations, which could have a cost as a technical barrier.

Exiting the Union would affect very much the Vehicles industry considering the level of integration and the tariff that could possible be applied, requiring careful negotiations to assure adequately low barriers to trade. Pharma sector likely be less affected given the already non existent tariff levels, only technical barriers could affect it, and given that Great Britain will not be asked to contribute to future legislation of the Union, new potential regulatory measures will not be influenced but only imposed if Britain wants to maintain or improve the current level of trade with EU countries.

## 6. Conclusions

The analysis shows that the level of integration of Great Britain with the EU is very high (196% more import / 84% more export), widespread through the sectors, especially concerning strategically crucial large sectors, like vehicle industry, machinery and mechanical appliances and electrical machinery (84-85) or the organic chemical (29) and plastic industries (39), but also for smaller but very integrated ones like the textile. The impact should be much easier to manage for sectors like the pharmaceutical one (30).

This brings serious concerns with regards to the future exit from the European Union.

Enjoying no more the single market will put Britain in a difficult position. We imagined a scenario in which the country traded under WTO law, this requires a decision on the level of trade barriers to impose which has to take account of the sectorial integration with Europe, which is very high in some important sectors which decisively depend on imports of intermediate goods from the continental union, such as the automotive industry.

These key sectors have to be preserved in negotiations even considering the export, otherwise economic shock will be high: indeed, industries facing significant barriers could be subsidized in theory but in such a case careful considerations have to be made in order to estimate the budget required. Considering the weight of the most integrated sectors it would be much higher than the EU membership fee. At that point it will be more convenient to pay a fee for a mixed membership (like EFTA or a series of bilateral ad-hoc agreements). Economic reasoning would predict an easily obtainable agreement, given British imports from the EU, however, political reasons could make this way more complicated, as it would mean giving concessions to a country that chose for the first time in history to exit the Union.

The analysis even showed some interesting facts on the other big international partners of Great Britain. Indeed, a natural solution for less trade with EU could be identified in improving the flows with the other countries in the world. The Chinese integration level is a large 175% more for import and not significant for export, but we have witnessed a constant and impressive growth especially since the beginning of the 2000's. The challenge here for the policymaker will be to keep it or improve the level of integration with a special attention to the export side. This in part depends on Chinese own policies, but on the other side, new bilateral agreements could be more difficult to achieve outside of the EU, because of a diminished contracting power, and on the other hand, China could conclude different beneficial agreements with other big economies such as the EU itself.

Integration with the US is not significant or even under the standard, with a -74% in export (even though we have to keep in mind the considerations made at page 28). In order to reach positive integration with the north American country, something similar to a comprehensive FTA like the TTIP would be beneficial, but again, here the point is if Britain has enough negotiating power in order to successfully conclude the deal in the best way for its interests. To sum up, the actual level of trade with EU is vital and must be preserved, otherwise an economic structure modification would be required. This opens to very challenging decisions for the policymaker in the near future, both British and European.

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## Appendix

Sector by sector EU coefficients and tariffs:

Sectors are listed according to decreasing average level of integration (avg). Numbers are reported only where the coefficients are significant.

Goods belonging to the top 10 of import or export share weight are highlighted.

| hs2 | import | export | avg   | MFN  | Description                                                                                                       |
|-----|--------|--------|-------|------|-------------------------------------------------------------------------------------------------------------------|
| 87  | 4.19   | 1.45   | 2.82  | 5.8  | Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof.                          |
| 61  | 4.27   | 1.22   | 2.745 | 11.7 | Articles of apparel and clothing accessories, knitted or crocheted.                                               |
| 48  | 3.91   | 1.29   | 2.6   | 0    | Paper and paperboard; articles of paper pulp, of paper or of paperboard.                                          |
| 22  | 3.14   | 1.49   | 2.315 | 3.9  | Beverages, spirits and vinegar.                                                                                   |
| 2   | 2.59   | 2.01   | 2.3   | 5.1  | Meat and edible meat offal.                                                                                       |
| 64  | 3.2    | 1.3    | 2.25  | 11.1 | Footwear, gaiters and the like; parts of such articles.                                                           |
| 95  | 2.8    | 1.68   | 2.24  | 2.3  | Toys, games and sports requisites; parts and accessories thereof.                                                 |
| 30  | 3.69   | 0.78   | 2.235 | 0    | Pharmaceutical products.                                                                                          |
| 58  | 2.54   | 1.92   | 2.23  | 7.3  | Special woven fabrics; tufted textile fabrics; lace; tapestries; trimmings; embroidery.                           |
| 54  | 2.23   | 2.08   | 2.155 | 6    | Man-made filaments.                                                                                               |
| 21  | 3      | 1.3    | 2.15  | 9.2  | Miscellaneous edible preparations.                                                                                |
| 8   | 3.46   | 0.82   | 2.14  | 5.9  | Edible fruit and nuts; peel of citrus fruit or melons.                                                            |
| 7   | 3.32   | 0.9    | 2.11  | 8.5  | Edible vegetables and certain roots and tubers.                                                                   |
| 83  | 3.18   | 0.99   | 2.085 | 2.5  | Miscellaneous articles of base metal.                                                                             |
| 51  | 2.37   | 1.77   | 2.07  | 3.5  | Wool, fine or coarse animal hair; horsehair yarn and woven fabric.                                                |
| 35  | 2.65   | 1.45   | 2.05  | 4.6  | Albuminoidal substances; modified starches; glues; enzymes.                                                       |
| 4   | 4.08   | 0      | 2.04  | 5.3  | Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included. |
| 96  | 2.85   | 1.19   | 2.02  | 3.3  | Miscellaneous manufactured articles.                                                                              |

|    |      |      |       |      |                                                                                                                                                                                          |
|----|------|------|-------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 39 | 2.94 | 1    | 1.97  | 6    | Plastics and articles thereof.                                                                                                                                                           |
| 60 | 1.77 | 2.11 | 1.94  | 7.9  | Knitted or crocheted fabrics.                                                                                                                                                            |
| 25 | 2.79 | 1.05 | 1.92  | 0.2  | Salt; sulphur; earths and stone; plastering materials, lime and cement.                                                                                                                  |
| 20 | 3.8  | 0    | 1.9   | 17.5 | Preparations of vegetables, fruit, nuts or other parts of plants.                                                                                                                        |
| 19 | 2.84 | 0.93 | 1.885 | 10.7 | Preparations of cereals, flour, starch or milk; pastrycooks' products.                                                                                                                   |
| 57 | 2.73 | 1.04 | 1.885 | 7.3  | Carpets and other textile floor coverings.                                                                                                                                               |
| 70 | 2.47 | 1.29 | 1.88  | 5    | Glass and glassware.                                                                                                                                                                     |
| 63 | 2.61 | 1.08 | 1.845 | 10.1 | Other made up textile articles; sets; worn clothing and worn textile articles; rags.                                                                                                     |
| 55 | 1.98 | 1.68 | 1.83  | 6.2  | Man-made staple fibres.                                                                                                                                                                  |
| 56 | 2.72 | 0.91 | 1.815 | 6    | Wadding, felt and nonwovens; special yarns; twine, cordage, ropes and cables and articles thereof                                                                                        |
| 32 | 2.29 | 1.3  | 1.795 | 5.5  | Tanning or dyeing extracts; tannins and their derivatives; dyes, pigments and other colouring matter; paints and varnishes; putty and other mastics; inks.                               |
| 42 | 2.11 | 1.46 | 1.785 | 4.6  | Articles of leather; saddlery and harness; travel goods, handbags and similar containers; articles of animal gut (other than silk-worm gut).                                             |
| 52 | 2.24 | 1.32 | 1.78  | 6.1  | Cotton, Impregnated, coated, covered or laminated textile fabrics; textile articles of a kind suitable for industrial use.                                                               |
| 59 | 1.71 | 1.85 | 1.78  | 6.1  |                                                                                                                                                                                          |
| 17 | 2.55 | 0.95 | 1.75  | 6.8  | Sugars and sugar confectionery.                                                                                                                                                          |
| 41 | 1.89 | 1.6  | 1.745 | 2    | Raw hides and skins (other than furskins) and leather.                                                                                                                                   |
| 49 | 2.43 | 1.06 | 1.745 | 0    | Printed books, newspapers, pictures and other products of the printing industry; manuscripts, typescripts and plans.                                                                     |
| 9  | 2.56 | 0.82 | 1.69  | 2.3  | Coffee, tea, mate and spices.                                                                                                                                                            |
| 12 | 1.83 | 1.53 | 1.68  | 1.2  | Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit; industrial or medicinal plants; straw and fodder.                                                                |
| 69 | 2.71 | 0.65 | 1.68  | 4.6  | Ceramic products.                                                                                                                                                                        |
| 85 | 2.66 | 0.65 | 1.655 | 2.8  | Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles, |
| 33 | 2.43 | 0.87 | 1.65  | 2.4  | Essential oils and resinoids; perfumery, cosmetic or toilet preparations.                                                                                                                |
| 74 | 1.79 | 1.49 | 1.64  | 3.3  | Copper and articles thereof                                                                                                                                                              |

|    |      |      |       |      |                                                                                                                                                                                                                                                                            |
|----|------|------|-------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 40 | 2,53 | 0.74 | 1.635 | 2.6  | Rubber and articles thereof                                                                                                                                                                                                                                                |
|    |      |      |       |      | Soap, organic surface-active agents, washing preparations, lubricating preparations, artificial waxes, prepared waxes, polishing or scouring preparations, candles and similar articles, modelling pastes, "dental waxes" and dental preparations with a basis of plaster. |
| 34 | 2.37 | 0.88 | 1.625 | 2    |                                                                                                                                                                                                                                                                            |
| 68 | 2.29 | 0.86 | 1.575 | 1.4  | Articles of stone, plaster, cement, asbestos, mica or similar materials.                                                                                                                                                                                                   |
| 66 | 2.13 | 0.95 | 1.54  | 4.3  | Umbrellas, sun umbrellas, walking-sticks, seat-sticks, whips, riding-crops and parts thereof                                                                                                                                                                               |
|    |      |      |       |      | Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings; lamps and lighting fittings, not elsewhere specified or included; illuminated signs, illuminated nameplates and the like; prefabricated buildings.                            |
| 94 | 3,01 | 0    | 1.505 | 2.3  |                                                                                                                                                                                                                                                                            |
| 24 | 2.99 | 0    | 1.495 | 44.7 | Tobacco and manufactured tobacco substitutes.                                                                                                                                                                                                                              |
| 44 | 2.95 | 0    | 1.475 | 2.2  | Wood and articles of wood; wood charcoal,                                                                                                                                                                                                                                  |
| 62 | 2.34 | 0.6  | 1.47  | 11.3 | Articles of apparel and clothing accessories, not knitted or crocheted.                                                                                                                                                                                                    |
| 72 | 1.17 | 1.73 | 1.45  | 0.3  | Iron and steel.                                                                                                                                                                                                                                                            |
| 1  | 2.61 | 0    | 1.305 | 1.2  | Live animals                                                                                                                                                                                                                                                               |
| 38 | 2.61 | 0    | 1.305 | 5.4  | Miscellaneous chemical products.                                                                                                                                                                                                                                           |
| 76 | 1.37 | 1.22 | 1.295 | 6.4  | Aluminium and articles thereof                                                                                                                                                                                                                                             |
| 11 | 2.28 | 0    | 1.14  | 12.2 | Products of the milling industry; malt; starches; inulin; wheat gluten.                                                                                                                                                                                                    |
| 73 | 2.22 | 0    | 1.11  | 1.7  | Articles of iron or steel.                                                                                                                                                                                                                                                 |
| 6  | 2.18 | 0    | 1.09  | 6.9  | Live trees and other plants; bulbs, roots and the like; cut flowers and ornamental foliage.                                                                                                                                                                                |
| 5  | 0    | 1.81 | 0.905 | 0.1  | Products of animal origin, not elsewhere specified or included.                                                                                                                                                                                                            |
| 27 | 0    | 1.8  | 0.9   | 0.8  | Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes.                                                                                                                                                                      |
| 84 | 1.67 | 0    | 0.835 | 1.8  | Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof                                                                                                                                                                                              |
| 23 | 0    | 1.51 | 0.755 | 0.8  | Residues and waste from the food industries; prepared animal fodder.                                                                                                                                                                                                       |
| 53 | 0    | 1.51 | 0.755 | 2.8  | Other vegetable textile fibres; paper yarn and woven fabrics of paper yarn.                                                                                                                                                                                                |
| 90 | 1.48 | 0    | 0.74  | 2.2  | Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; parts and accessories thereof                                                                                                                       |
| 29 | 0    | 1.35 | 0.675 | 4.3  | Organic chemicals.                                                                                                                                                                                                                                                         |

|    |      |      |       |      |                                                                                                                                                                                                                        |
|----|------|------|-------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 86 | 1.33 | 0    | 0.665 | 1.7  | Railway or tramway locomotives, rolling-stock and parts thereat railway or tramway track fixtures and fittings and parts thereof; mechanical (including electro-mechanical) traffic signalling equipment of all kinds. |
| 10 | 0    | 1.32 | 0.66  | 2.2  | Cereals.                                                                                                                                                                                                               |
| 65 | 0    | 1.3  | 0.65  | 2.3  | Headgear and parts thereof                                                                                                                                                                                             |
| 14 | 1.28 | 0    | 0.64  | 0    | Vegetable plaiting materials; vegetable products not elsewhere specified or included.                                                                                                                                  |
| 67 | 0    | 1.27 | 0.635 | 2.8  | Prepared feathers and down and articles made of feathers or of down; artificial flowers; articles of human hair.                                                                                                       |
| 79 | 0    | 1.13 | 0.565 | 3.1  | Zinc and articles thereof.                                                                                                                                                                                             |
| 15 | 0    | 1.03 | 0.515 | 5.4  | Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes.                                                                                                        |
| 3  | 0    | 0.99 | 0.495 | 11.1 | Fish and crustaceans, molluscs and other aquatic invertebrates                                                                                                                                                         |
| 37 | 0    | 0.97 | 0.485 | 5.5  | Photographic or cinematographic goods.                                                                                                                                                                                 |
| 50 | 0    | 0.96 | 0.48  | 3.1  | Silk.                                                                                                                                                                                                                  |
| 28 | 0    | 0.93 | 0.465 | 4.5  | Inorganic chemicals; organic or inorganic compounds of precious metals, of rare-earth metals, of radioactive elements or of isotopes.                                                                                  |
| 36 | 0    | 0.91 | 0.455 | 6.3  | Explosives; pyrotechnic products; matches; pyrophoric alloys; certain combustible preparations.                                                                                                                        |
| 31 | 0    | 0.83 | 0.415 | 4.8  | Fertilisers.                                                                                                                                                                                                           |
| 92 | 0    | 0.69 | 0.345 | 3.2  | Musical instruments; parts and accessories of such articles.                                                                                                                                                           |
| 13 | 0    | 0.6  | 0.3   | 2.3  | Lac; gums, resins and other vegetable saps and extracts.                                                                                                                                                               |
| 82 | 0    | 0.42 | 0.21  | 3.1  | Tools, implements, cutlery, spoons and forks, of base metal; parts thereof of base metal.                                                                                                                              |
| 16 | 0    | 0    | 0     | 18.2 | Preparations of meat, of fish or of crustaceans, molluscs or other aquatic invertebrates.                                                                                                                              |
| 18 | 0    | 0    | 0     | 6.1  | Cocoa and cocoa preparations.                                                                                                                                                                                          |
| 26 | 0    | 0    | 0     | 0    | Ores, slag and ash.                                                                                                                                                                                                    |
| 43 | 0    | 0    | 0     | 1.2  | Furskins and artificial fur; manufactures thereof.                                                                                                                                                                     |
| 46 | 0    | 0    | 0     | 3    | Manufactures of straw, of esparto or of other plaiting materials; basketware and wickerwork.                                                                                                                           |
| 47 | 0    | 0    | 0     | 0    | Pulp of wood or of other fibrous cellulosic material; recovered (waste and scrap) paper or paperboard.                                                                                                                 |
| 71 | 0    | 0    | 0     | 0.6  | Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metal and articles thereof; imitation, jewellery; coin.                                                       |

|    |       |       |        |     |                                                     |
|----|-------|-------|--------|-----|-----------------------------------------------------|
| 75 | 0     | 0     | 0      | 0.7 | Nickel and articles thereof.                        |
| 78 | 0     | 0     | 0      | 2.3 | Lead and articles thereof                           |
| 80 | 0     | 0     | 0      | 0   | Tin and articles thereof.                           |
| 89 | 0     | 0     | 0      | 1.1 | Ships, boats and floating structures.               |
| 91 | 0     | 0     | 0      | 4.2 | Clocks and watches and parts thereof.               |
| 93 | 0     | 0     | 0      | 2.2 | Arms and ammunition; parts and accessories thereof. |
| 99 | 0     | 0     | 0      | .   | Reserved for special uses by Contracting Parties    |
| 88 | 0     | -0.82 | -0.41  | 3.3 | Aircraft, spacecraft, and parts thereof.            |
| 81 | -1.41 | 0.57  | -0.42  | 3   | Other base metals; cermets; articles thereof.       |
| 45 | 0     | -1.06 | -0.53  | 2.7 | Cork and articles of cork.                          |
| 97 | 0     | -1.85 | -0.925 | 0   | Works of art, collectors' pieces and antiques.      |

Sector by sector coefficients: USA and China

| hs2 | USA imp | USA exp | China imp | China exp |
|-----|---------|---------|-----------|-----------|
| 1   | 4.7     | 0       | 0         | -1.81     |
| 2   | 0       | 1.44    | 0         | 3.18      |
| 3   | 0       | 0.97    | 2.73      | 2.43      |
| 4   | 0       | 0       | 2.51      | -1.52     |
| 5   | 0       | 0       | 4.78      | 1.69      |
| 6   | 0       | 1.46    | -1.5      | -1.38     |
| 7   | 0       | -1.04   | 0         | 0         |
| 8   | 0       | 0       | 0         | 0.76      |
| 9   | 0       | 0       | 0         | -0.75     |
| 10  | 0       | 1.53    | -1.94     | -1.66     |
| 11  | 0       | 0       | -1.12     | 0         |
| 12  | 2.04    | 0       | 1.06      | 0         |
| 13  | 0       | 0       | 0         | -0.5      |
| 14  | 0       | 0       | 2.11      | -0.76     |
| 15  | 0       | -1.28   | 0         | 0         |
| 16  | 2.57    | -0.9    | 0         | 0         |
| 17  | 0       | 0       | 1.81      | 0.9       |
| 18  | 0       | 0       | 0         | -1.31     |
| 19  | -1.05   | -1.52   | 1.59      | 0         |
| 20  | -1.58   | -1.17   | 0         | 0         |
| 21  | -1.41   | -1.19   | 0         | 0         |
| 22  | 0       | 0.71    | 0         | -0.98     |
| 23  | 2.7     | -1.88   | 0         | -0.74     |
| 24  | 0       | 0       | 0         | -2.4      |
| 25  | 0       | -2.27   | 1.73      | 0         |
| 26  | 0       | 0       | 0         | 0         |
| 27  | 0       | 2.67    | 0         | 0         |
| 28  | -1.23   | -1.31   | .97       | 0         |
| 29  | -1.96   | 0       | 2.27      | -0.83     |
| 30  | 0       | -1.57   | 2.8       | -0.5      |
| 31  | 0       | 0       | 0         | 0         |
| 32  | -1.35   | -1.8    | 2.62      | 0         |
| 33  | 0       | -1.8    | 1.87      | -1.55     |
| 34  | 0       | -2.25   | 2.99      | 0         |
| 35  | 0       | -0.68   | 0         | 0         |
| 36  | 1.48    | 0       | 4.34      | 0         |
| 37  | -1.8    | 0       | 1.31      | 0.6       |
| 38  | 0       | -1.47   | 1.59      | -0.8      |

|    |       |       |       |       |
|----|-------|-------|-------|-------|
| 39 | -2.14 | -1.59 | 2.82  | 0     |
| 40 | -2.03 | -1.21 | 0     | 0.58  |
| 41 | 0     | 0     | -1.52 | 1.76  |
| 42 | -2.49 | -0.77 | 3.36  | 0     |
| 43 | 0     | 0     | 4.45  | 0     |
| 44 | 0     | -0.9  | 1.97  | 1.16  |
| 45 | 0     | -1.18 | 3.43  | 0     |
| 46 | 0     | 0     | 4.68  | 0     |
| 47 | 0     | -1.91 | -2.7  | 2.8   |
| 48 | -1.46 | -1.71 | 1.45  | 0     |
| 49 | 0     | -1.76 | 4.17  | 0     |
| 50 | 0     | 1.54  | 0     | 0     |
| 51 | 0     | 0     | 3.56  | 1.87  |
| 52 | 0     | 0     | 0     | 0     |
| 53 | 0     | 0.93  | 0     | 0     |
| 54 | 0     | 0     | 0     | 0.94  |
| 55 | 0     | 0     | 0     | 0.46  |
| 56 | 0     | 0     | 1.71  | 0     |
| 57 | 0     | 0.51  | 2.59  | 0     |
| 58 | 0     | 0     | 2.51  | 0     |
| 59 | 0.89  | -1.27 | 2     | 0     |
| 60 | 0     | 0     | 1.77  | 0.77  |
| 61 | 0     | -1.28 | 1.84  | 0     |
| 62 | -1.83 | -1.18 | 2.97  | -0.65 |
| 63 | -1.31 | 0     | 3.23  | -0.54 |
| 64 | -1.99 | -0.6  | 2.66  | 0     |
| 65 | -1.83 | 0     | 3.22  | 0.44  |
| 66 | -2.47 | 0     | 6.02  | 0     |
| 67 | 0     | 0     | 4.68  | .81   |
| 68 | 0     | -1.1  | 1.94  | .52   |
| 69 | -1.3  | -0.93 | 1.71  | 0.35  |
| 70 | -1.51 | -1.41 | 2.7   | .61   |
| 71 | 0     | 0     | -1.09 | 1.39  |
| 72 | 0     | -1.31 | 1.12  | .92   |
| 73 | -1.81 | -1.9  | 2.9   | 0     |
| 74 | -1.69 | -1.54 | 0.89  | 2.71  |
| 75 | 0     | -1.15 | 0     | 1.48  |
| 76 | 0     | -1.28 | 2.44  | 1.81  |
| 78 | 0     | -2.15 | 0     | 0     |
| 79 | 0     | 0     | 2.87  | 1.73  |
| 80 | 0     | 0     | 0     | 1.39  |
| 81 | 1.51  | 0     | 3.44  | 0     |

|    |       |       |       |       |
|----|-------|-------|-------|-------|
| 82 | -1.47 | -1.12 | 3.34  | -0.56 |
| 83 | -2.14 | -1.54 | 3.23  | 0.72  |
| 84 | -1.67 | -1.39 | 2.28  | 0     |
| 85 | -1.53 | -1.51 | 3.37  | 0.35  |
| 86 | 0     | -1.28 | 4.75  | 1.1   |
| 87 | 0     | -0.92 | 1.94  | -0.42 |
| 88 | 0     | 0     | 0     | -2.9  |
| 89 | 0     | 0     | 3.09  | 0     |
| 90 | 0     | -1.01 | 2.52  | 0     |
| 91 | -1.93 | 0     | 5.38  | 0     |
| 92 | 0     | 0     | 4.13  | 0     |
| 93 | 2.87  | 1.32  | 1.28  | 0     |
| 94 | 0     | -0.65 | 3.76  | 0.95  |
| 95 | 0     | 0     | 4.49  | 0.66  |
| 96 | -1.36 | -1.05 | 3.1   | 0     |
| 97 | 1.24  | 1.01  | 1.43  | 0.51  |
| 99 | 0     | -1.07 | -1.38 | 0     |