BANK ĊENTRALI TA' MALTA
EUROSISTEMA
CENTRAL BANK OF MALTA

The gravity model for Maltese goods exports and imports

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WP/01/2019

April 2019

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Abstract

Malta's path of economic development benefited from international trade, as the country is situated on trade routes linking Europe, Africa and Asia. This paper aims to look at the country's location, trade agreements, cultural attributes and size in a gravity model framework. Its almost 50 year old relationship with the EU and its precursors, coupled with its strategic location, led to extraordinary growth rates in trade in goods between 1960 and 2016. The various versions of the gravity model applied here suggest strong and significant impacts of successive trade agreements with the European continent for both exports and imports. This is looked at using nominal, real and sectoral data. Nominal figures show how for every 10.0% difference in distance, exports and imports fall by 11.1% and 7.5% respectively, on average across the methodologies used. In real terms, a 10.0% difference in distance decreases real exports by 6.9%, on average, across the methodologies, and imports by 5.5%.

JEL classification: C23, F1, F14, F15.
Keywords: Trade; gravity model; free trade agreements; spatial econometrics; Malta;

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1. Introduction

The economy of Malta is very open to trade, showing one of the highest openness ratios in the world. As noted in Grech (2015), exports and imports stood at 165% of GDP at independence, with the ratio rising above 200% in the 1970s and 1980s. By the 1990s, this trend rose close to 250%, and further accentuated following EU accession. In fact, in recent years, exports and imports of goods and services together have exceeded GDP by three times. Excluding services, this ratio falls to just under 70% of GDP in 2017. This success story is also evident in external trade statistics. In nominal balance of payments figures, exports and imports rose by more than 14,000% and more than 11,000% respectively, between 1960 and 2016.[1] In real terms, these growth rates translate to an increase of around 2,100% and 1,200%, respectively.

The first part of this study constructs a number of gravity equations for goods export and import flows, in nominal terms, for Malta for the years 1960 to 2016. The figures are based on customs data, and are aggregated to totals. The study expects to find strong geographical effects in trade, as predicted by the literature, as well as cultural effects. A further hypothesis of the study is that Malta's Association Agreement with the European Economic Community (EEC) in 1970, and its membership of the European Union in 2004, had a strong and positive impact on Malta's goods imports. The former led to a lowering of Maltese import duties from the EU and an expansion by the manufacturing industry which required the importation of industrial supplies. Malta's accession to the EU in 2004 required Malta's full membership in the EU Customs Union (EUCU). This implied the imposition of tariffs on extra-EU imports, which can be expected to have had substitution effects towards intra-EU substitutes.

On the other hand, prior expectations of the impact on goods exports are not as clear cut for both agreements. A priori, the 1970 Association Agreement which allowed labour-intensive

[1]This also includes trade in services.

manufacturing industries to thrive and export goods from Malta is expected to have had a positive effect on Maltese exports. The 1970 Association Agreement allowed manufacturers in Malta to benefit from - at first - a reduced rate of import duties on their exports towards the European community and, at a later date, their full exemption (Borg and Inguanez, 1993). However, it is difficult to assess the impact of EU membership in 2004, with a large number of labour-intensive industries being affected negatively, while others were affected positively. This strong element of structural change is rather hard to capture in simple gravity models, which exclude sectoral data.

Finally, Malta's membership in the Economic and Monetary Union had to be excluded in this study. Malta adopted the euro in 2008, at the start of one of the largest disruptions in international trade patterns since the 1930s. Moreover, Malta's process of integration in the European value-added chain began in the 1970s, with a benign regime of stable exchange rates spanning multiple decades. While economic theory suggests numerous positive effects in international trade from euro adoption, discretion in the interpretation of euro area membership required the exclusion of this variable, at least until enough observations are available for a more meaningful analysis.[2]

The second part of the analysis deals with more recent sector data in Malta for the period 2000 - 2017. This part of the study attempts to remove the effects of trade in a number of volatile sectors, such as fuel oil and trade in ships. The results of this subsidiary set of gravity equations, which serve as a robustness check, are rather close to the previous estimates in most cases, except for the variables accounting for the common institutional and cultural background. This might be the impact of excluding these volatile trade flows, or an artefact of the time-period - which includes a global financial and economic crisis - or preferential trade-shifting towards EU countries following Malta's EU accession in 2004.

[2]Preliminary regressions indicated insignificance of the euro area coefficient. Attempts were made to include variables to capture global trade volatility in this study, however their coverage was sparse in the early decades. Their inclusion over a more limited time span was ineffective.

In the previous two analyses, nominal figures are used due to the unavailability of trade volume indices going back to the 1960s. In the third part of this study, the regressions are estimated again using national accounts deflators for aggregate exports and imports. On the export side, the results show positive and significant results with the magnitudes of the coefficients above 1.0 for the MT-EEC Agreement dummy variable, with the coefficient resting between 1.8 and 3.1 between different methodologies. For the import side, the coefficient on the MT-EEC Agreement also returns positive and significant results - resting between 1.3 and 3.6. The magnitudes and the significance suggest that the EEC countries were both a significant destination of Maltese exports, as well as a source of imports. The EU accession dummy variable has a positive and significant coefficient in models on the export side, and a significant and positive coefficient on the import side. The ranges of the estimates on the export side, however, are lower than those for the MT-EEC Agreement. Conversely, the magnitudes of the EU dummy variable coefficients on the import side are greater than those for the MT-EEC Agreement dummy variables.

These coefficients would imply that the Association Agreement between Malta and EEC made it - on average across the methodologies - around 1,120% more likely for Malta to export towards a country which was part of the then-EEC. Likewise, Malta's membership in the EU increased the likelihood of exports towards the EU - on average - by around 335%. These figures compare well with numbers found in the literature, which discuss how - for example - Eastern Partnership countries would experience a 311.0% increase in exports with full EU accession, (Martínez-Zarzoso et al., 2014), export enhancing effects of 945.4% in Ekanayake et al. (2010) for Asian trade agreements and a higher than ten-fold increase in trade occurs over a ten year period in developing countries. In the Maltese case, however, the use of national accounts deflators to deflate customs trade data forces a careful interpretation of these figures. Moreover, the scope of changes to the fabric of the Maltese economy over the past decades, with new products and new industries establishing themselves in the country, also require an element of caution in interpreting these results.

This paper is structured as follows. A literature review looks at literature on Maltese trade, and gravity model studies, a section on data discusses the sources of the data and calculates trade intensity indices for 2016. A methodology section discusses in more detail the literature and methods to construct gravity models, with the results presented afterwards while a conclusion closes the study.

2. Literature Review

Malta's economy emerged from a system based around the servicing of British military forces in the 1950s and 1960s, to become a very dynamic economy in the Mediterranean region, with high value-added goods exports in the technological sector, as well as financial services and tourism. This development reflected a number of policy measures, which allowed a continued process of economic renewal to take hold and expand in new industries. This process allowed Malta to embrace and be resilient to strong shocks in the global economy, allowing for periods of fast economic growth and improved living standards.

In fact, over the period 1965-2017, the Maltese economy grew steadily at an average rate of 5.8% in real terms. Living standards improved considerably over this period. Malta's economic growth reflects its foreign trade performance. Total trade as a percentage of nominal GDP stood at 157.0% in 1965, rising to 254.0% in 1995, and reaching a high of 325.9% in 2012. Key turning points in Malta's economic development came with the signing of an association agreement with the EEC in 1970, the setting up of an international financial services centre in the mid-1990s, and the accession to the European Union in 2004.

This growth in Malta's foreign trade has not drawn a lot of attention from researchers. Indeed, aside from analyses based on the composition of Maltese trade with the expected impact of the 2008/9 crisis, (Azzopardi, 2009), and a simple gravity model analysis on merchandise trade flows between Malta and the EU (Spiteri, 2008), there does not appear to be an attempt to study the breadth of Maltese trade flow patterns over time.

The study presented here takes a similar route to analyses carried out in research for other countries, and examines comprehensively trade relationships between Malta and its trading partners within the context of a gravity model. These models have been frequently applied in order to analyse international trade. Many of these studies have focused on examining trade relations in a region or within a particular trading block, such as Anderson and van

Wincoop (2003), Eaton and Kortum (2002), Haveman and Hummels (2004); Lawless (2010), Lim (2011) and Magerman et al. (2016). Other studies have examined trade gravity models against a group of trading partners, Antonucci and Manzocchi (2006), Blomqvist (2004), Kristjánsdóttir (2005), Bussière and Schnatz (2009), Jinhwan and Orgilbold (2011), Nguyen (2010), Narayan and Nguyen (2016) and Irshad et al. (2017). For Malta, only one study was found - Spiteri (2008), who examines Maltese trade flows with the EU using the panel gravity approach.

The literature finds very strong impacts from regional trade agreements, with both countries and sectors returning very strong increases in trade likelihoods following trade integration. These tend to have a strong significant effect on intra-regional trade with very large magnitudes. A review of the literature relating to African countries, for instance, discusses how magnitude predictions range from 172% to 1000% (Afesorgbor, 2016). Vollrath and Hallahan (2009) find that a 10.5-fold increase in trade between low income countries occurs over a ten year period. This increase would not have occurred in the absence of mutual trade agreements. Martínez-Zarzoso et al. (2014) argue that Eastern Partnership countries would experience a 311% increase in exports with full EU accession. In Poland, trade effects from EU accession were measured at between 72.8% and 502.5% (Brodzicki et al., 2015). The export enhancement effect of regional trade agreements in Asia was calculated at 945.4% in Ekanayake et al. (2010). These latter economies, particularly small open economies like Singapore, Taiwan Province of China and Hong Kong share some broad similarities with Malta's development path, colonial history and strategic location in their neighbourhoods.

The contribution of the study being presented here to the gravity model literature comes from an analysis of the impact of trade agreements between Malta and its closest European trading partners. In this study the influence of Malta's two key trade arrangements (namely, the 1970 Association Agreement, and EU membership) on Malta's bilateral trade relations.

Malta's trade relations

The economic renewal process by successive Maltese governments from the fifties onward enabled the transition from a fortress economy, to a fully-fledged market oriented economy. It also set the scene for the deepening of Malta's trade integration with its immediate economic neighbourhood. In particular, it encouraged trade with Europe and North Africa, as well as across the world. Trade reforms have come in various forms. The establishment of industrial zones and the construction of a freeport improved Malta's infrastructural trade platform, while business friendly regulation and investment aid helped to attract foreign investment. A broadly stable exchange rate may also have served to promote trade links.

Moreover, over the years, Malta became a signatory to important regional and non-regional bilateral and multilateral trade agreements. These have clearly helped Malta to access international markets. Malta became a member of GATT on November 17, 1964 and joined the WTO in January 1995. An association agreement with the then-EEC was signed in December 1970. This was the third agreement between the Community and a non-Member State, following the ones with Greece (1961) and Turkey (1963).

The Association Agreement with Malta came into force in April 1971, and it aimed to strengthen and extend the two parties' trade relations. The agreement considered two stages, each with a length of five years. The first stage aimed to eliminate the trade barriers between Malta and the EEC. Thus, many Maltese exports to the EEC began to benefit from a reduced rate of import duties. At a later date, these were totally exempted from tax. On the other hand, Malta reduced customs duties it charged on imports from the EEC.

The final target of the second stage, as planned, was the creation of a customs union. This was set to start in 1976. However, by that time, the Maltese government chose not to set in motion this customs union. The first stage was thus extended to June 1977, at first, and then extended to December 1980. The EEC then extended the agreement unilaterally until

December 1988. A supplementary protocol was then signed, which extended the Association Agreement until December 1990. A further protocol was concluded, which extended the first stage of the EEC-Malta agreement until December 1991, with an additional provision which extended the agreement automatically annually. In practical terms, this was an indefinite extension which enabled Malta to benefit from this trade agreement until Malta and the (by then) EU opened negotiations for Malta's accession to the EUCU.

It is apparent that between 1971 and 2004, Maltese industry benefited from a protective situation - Malta's accession to the EU began to expose the Maltese economy to EU-wide competition. Moreover, from 2004 onward, Maltese industry also had to face EU competition policy, especially provisions on state aid, liberalisation and monopolies. The economy was transformed into one based primarily on services exports, while the manufacturing sector - which had specialised in particular sectors such as textiles - shifted towards higher-value products. This was achieved, surprisingly, with few labour market shocks, with the economy maintaining steady, but low, growth until 2012.

3. Data

For the first part of this analysis, which focuses on nominal and real aggregate exports and imports, trade data for this analysis were sourced from IMF Direction of Trade Statistics (DOTS). The years included in the study range from 1960 to 2016. There are more than 200 countries and territories included in the study, with coverage depending on data availability.[3] Information relating to geographical distances, common cultural background, including languages and colonial history, were obtained from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) databases, following Mayer and Zignago (2011). The CEPII provides also a large set of important variables which cover a wide array of geographical characteristics for almost all countries in the world. Data include variables for countries which are contiguous, if they share a common language, whether they had a common coloniser after 1945, if they have ever had a colonial link, if there was a colonial relationship between the countries after 1945, or if the countries remain in some sort of a colonial relationship, or if a number of countries ever were part of a larger country.

There are two common languages dummies in the dataset. The first is based on whether two countries share a common official language. The other variable considers a relationship between two countries if a language is spoken by at least 9.0% of each respective country's populations. As Kristjánsdóttir (2005) argues that trade in smaller economies is driven by different dynamics than in larger countries, such cultural variables are deemed to be important to assess trade in Malta.

The two variables of interest for this study in the CEPII database are the common official language variable, and the common coloniser before 1945 variable. As an aside, a precise definition on what constitutes a colonial relationship is beyond the scope of this study. Mayer and Zignago (2011) apply the term colonisation as a very broad term which is used to

[3]The study, however, excludes bunkering trade - that is, trade with ships just outside Malta's territorial waters.

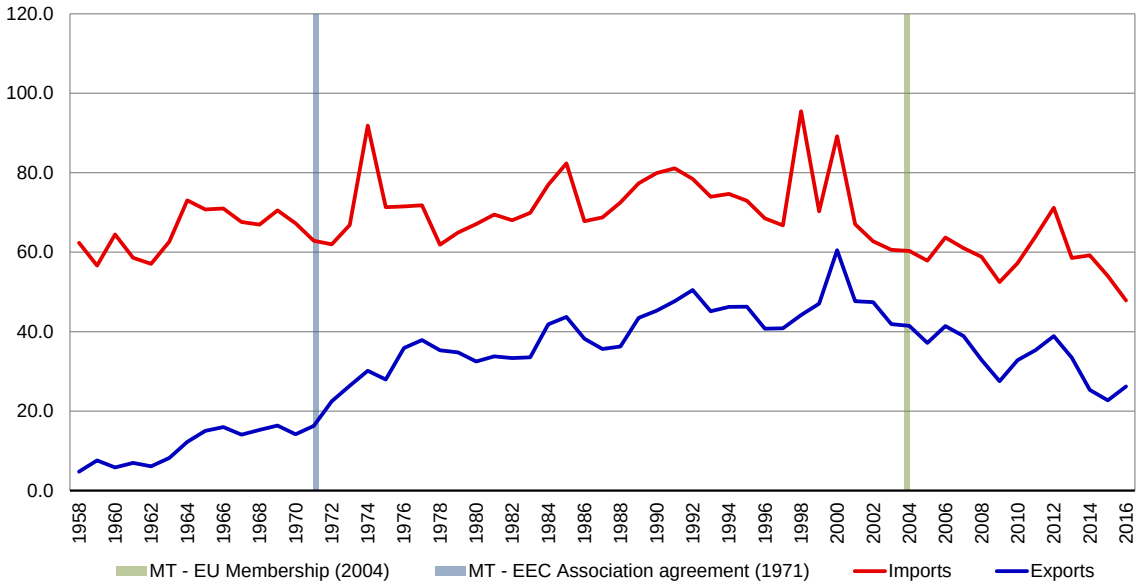
describe a relationship between countries, irrespective of their development levels, in which one governed the other over a long period of time, and contributed in some way to the current makeup of its institutions.

Data on population, gross domestic product, price indices were obtained from a World Bank dataset. EUROSTAT COMEXT data was used when looking at aggregate flows cleaned from trade in fuels, ships and aircraft. This database has disaggregated data from 2000 onward, which was used to supplement the findings of the analysis carried out for the longer aggregated time series.

National accounts deflators were used to deflate Maltese GDP, and in the absence of unit-value indices for the trade flows going back to the 1960s, national accounts deflators were used to deflate trade data.[4] Data was converted to US dollar values using historic exchange rates obtained from the European Central Bank's Statistical Data Warehouse. For pre-1999 figures, euro to US dollar exchange rates are theoretical ones, and they are based on European Currency Unit (ECU) values. Before March 1979, ECU rates are theoretical, and based on European Unit of Account values, and a basket of European countries' currencies prior to 1975. Historical time series on Maltese macroeconomic variables obtained from Grech (2015) were very helpful to construct the dataset for the period of interest.

[4]While it is common knowledge that trade is not a 'nominal' but a 'real' phenomenon, a number of studies are still carried out using nominal figures due to the unavailability of adequate deflators. This study attempts to use national accounts deflators. See Fuchs and Wahlrabe, (2005) and a discussion by Baldwin (1994).

Chart 1
Malta: Trade levels for goods
(Exports and imports of goods as a percentage of GDP)



Source: IMF DOTS, Grech (2015), and author's calculations.

Malta's trade patterns

Malta's strategic position and its harbour facilities have allowed the Maltese to trade and attract goods for centuries, both for the national economy and for transhipment. In the first half of the twentieth century, the Maltese economy specialised in servicing British navy and air-force bases, with facilities spread around the islands' natural harbours and central plains. As Malta moved towards independence, the economy began to shift slowly towards other sources of revenue. The tourist and manufacturing industries began to contribute increasingly more to the Maltese economy.

A number of stylised facts may be drawn when looking at the shares of goods exports and imports in GDP. Goods exports, in particular, surged from very low levels as a proportion of GDP, to reach a level of around 40.0% by the late-1980s (see Chart 1). Exports as a share of GDP grew at almost exponential rates until the mid-1970s. The ratio then stabilised somewhat, although it remained trending upwards. The upward trend from the

1960s onward appears to have stabilised somewhat by the early-1990s, before the share began to trend downward. Grech (2015) attributes this to two factors, namely decreasing semiconductor prices and price-effects from trade in fuels.

Moreover, the emergence of multiple services industries over the past twenty years implies that both the imports and exports of manufactured goods will tend to represent a diminishing proportion in GDP. Except for a number of one-off years, the import proportion to GDP, however, remained broadly stable until 2000. This finding makes sense in an economy which lacks raw materials and natural resources. Moreover, it is also apparent that, as exports grew, the wedge between goods imports and exports narrowed considerably until 2000.

One must also note that there are differences in coverage and timing between the GDP national accounts dataset, and trade data. The latter are complementary to the national accounts, however they are not identical. Exports and imports of goods in trade data are adjusted for balance of payments and national accounts purposes. Merchandise trade data also includes imports and exports of goods made by non-resident companies. These transactions are not considered part of Malta's balance of payments. Consequently, these imports and exports are subtracted from the totals in the national accounts.[5]

[5]If necessary, imports for certain goods by Maltese resident companies are also imputed (for further details see Methodological Notes in **NR197/2018**).

Direction of trade

Malta's major trading partners include its EU partners, as well as China, Japan, Singapore, Hong Kong, India, Turkey, Switzerland and Libya.[6] The top thirty partners in the dataset accounted for over 90.0% of trade flows in Malta, or $7.6 billion in trade flows out of a total in trade flows between sovereign nations of $8.3 billion.[7] Around 60.0% of this trade was directed towards European countries, around 20.0% to the United States and Canada combined, and around 10.0% to China, Hong Kong, Singapore and Japan combined. The large share of trade with Europe ought not be surprising, given Malta's membership of the EU, and its close proximity to Italy (see Chart 2). Incidentally, Italy is listed as the country's largest trade partner in terms of summed trade flows.[8]

Trade intensity indices are calculated using this dataset (see Table 1). Trade intensity indices measure the extent to which the proportion of a country i's trade to another country j differs from the proportion of trade from the rest of the world to country j. The index is given as:

$$TI_{ij}^{X,M} = [\tfrac{(T_{ij}^{X,M})}{(T_{i}^{X,M})}]/[(T_{wj}^{X,M} - T_{ij}^{X,M})/(T_{w}^{X,M} - T_{i}^{X,M})]$$

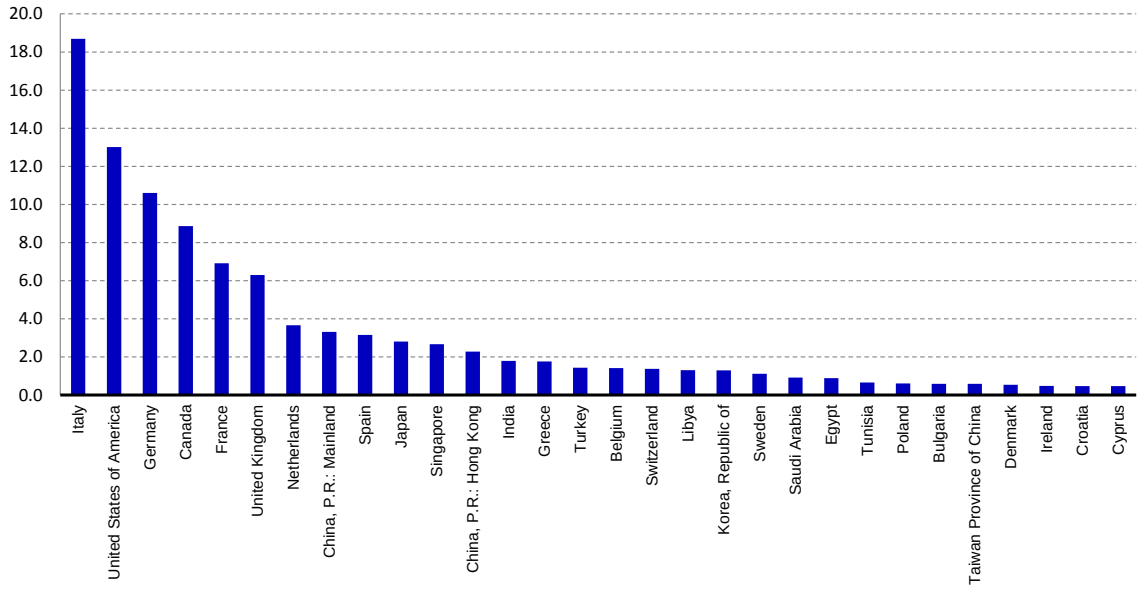
where $TI_{ij}^{(X,M)}$ is the intensity index of country i with trading partner j, for exports (X) or imports (M), respectively. For exports, T_{ij}^{X} is the exports of country i to trading partner j. T_{i}^{X} is the total exports of country i, T_{wj}^{X} is the total world exports to country j, and T_{w}^{X} is the total world exports. The index measures the extent to which country j is over

[6]For the purposes of this section of the study, trade flows are defined as the summation of nominal exports and imports in one calendar year. This analysis focuses on the top thirty partners for Malta, defined as sovereign nations. Trade on the high seas or to aircraft stores is excluded.

[7]Due to revisions and changes in vintages, these figures may not be directly comparable with the current published figures for international trade data obtainable from NSO.

[8]In the analysis, an attempt was made to replace the geographical distance between Malta and Italy as found in the CEPII database, which is the distance between Rome and Malta, and to replace it with the distance between Malta and the nearest Italian harbour link - Pozzallo. While this would better capture the imports of basic foodstuffs from Sicily, it was deemed to be distorting to the results given that Italian manufacturing industries are clustered in northern Italy. In that sense, the distance to Rome - being the mid-point between the industrial basins of the north and Sicily, was deemed to be a non-distortive compromise.

Chart 2
Malta: Trade flow direction in 2016
(summation of exports and imports, percentage)



Source: IMF DOTS, author's calculations.

or under-represented as a proportion of country i's export market. The index takes a value of unity if the proportion of country i's exports to country j is the same as the proportion of the rest of the world's exports to country j. If the value is higher than unity, country j is over-represented as country i's exports market. A value lower than unity implies relative under-representation when compared with the rest of the world's exports.

Table 1 shows how Malta's exports to Libya are highly over-represented, highlighting Maltese exporters' historical ability to trade in that particular market. Malta is also over-represented on the exports side with its exports to Singapore, France and Germany. This may be due to Malta's exports of semiconductors. On the import side, Maltese imports are over-represented in their imports from Cyprus and Greece in particular, as well as from many other countries. Disaggregated data suggests that the case in Cyprus reflects trade in ships, boats and floating structures, while for Greece this is due to trade in mineral fuels. In a sense, this serves to highlight the problems these two sectors cause in the analysis of Maltese trade. One can assume that, due to Malta's small economy and one-off transactions in these sectors, the

intensities will shift and change from year to year. In that sense, it appears important to exclude flows in certain sectors when estimating a gravity model, at the very least to serve as a robustness check. One of these sectors, namely trade in fuels, is also identified in Grech (2015) as a source of distortion in trade data. No sectoral thresholds were assumed to evaluate the choice of these sectors for the robustness check other than the striking estimates in Table 1.

Moreover, the results in general also underscore Malta's inability to export manufactured goods without importing industrial supplies and raw materials and its lack of basic resources such as food and refined fuels. Of course, these trade intensities represent only a view of the situation in a particular vintage of 2016 data.

Finally one can look at the trade in levels for Malta over time (Chart 3). It is apparent that trade in Malta surged from very low levels, with the country's economy shifting from servicing British armed forces, to the creation of a thriving manufacturing base, as other parts of the economy matured. Trade in Malta was open to successive international or bilateral agreements, which can be seen to have somehow affected these flows. This study focuses on two, the Malta - EEC association agreement (from 1971), and Malta's EU membership (2004). The agreements regulate tariffs and mutual recognition standards. As an EU member, Malta levies customs duties on non-EU imports. The Import Duties Act defines the rates of duties on each item, and according to their source.[9] Imports are also charged Value Added Tax.[10] Importers have to declare goods which is updated and published annually.[11] For example, the average tariff for US importers to export to the EU stands at around 3.0%.[12]

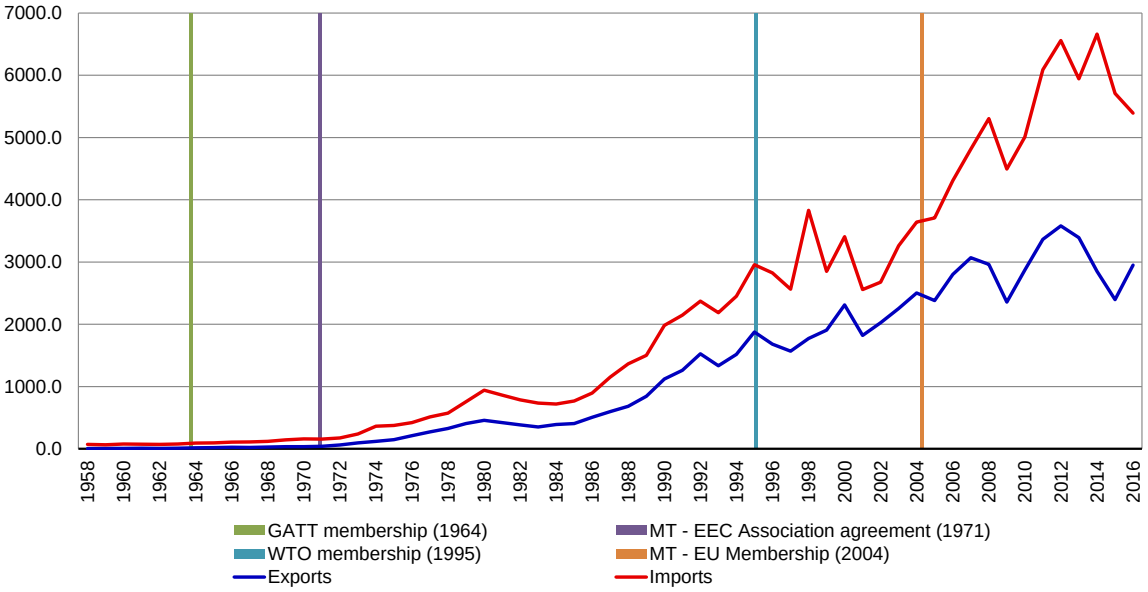
Malta removed most of its restrictions on imports gradually over time, with the process

[9]The Import Duties Act can be consulted online **here**.
[10]The various dispositions on value added tax in Malta, including adjustments, exemptions and refunds, may be consulted online **here**.
[11]These are available online on the European Commission website, **here**.
[12]See: `https://www.export.gov/article?id=Malta-Import-Tariffs`.

Table 1: Trade intensity indices (2016)

	Export intensity	Import intensity
Italy	1.6	8.1
United States of America	1.8	0.3
Germany	2.0	0.8
Canada	0.4	4.8
France	2.2	1.5
United Kingdom	0.9	2.7
Netherlands	0.4	1.4
China, P.R.: Mainland	0.2	0.2
Spain	0.6	2.2
Japan	1.5	0.2
Singapore	3.3	0.5
China, P.R.: Hong Kong	1.1	1.4
India	0.3	1.4
Greece	0.9	14.8
Turkey	0.4	1.9
Belgium	0.2	0.8
Switzerland	0.6	0.7
Libya	51.5	4.3
Korea, Republic of	0.4	0.4
Sweden	0.4	1.5
Saudi Arabia	1.0	0.8
Egypt	0.9	6.6
Tunisia	1.8	9.6
Poland	0.5	0.4
Bulgaria	1.0	4.5
Taiwan Province of China	0.1	0.3
Denmark	0.4	1.1
Ireland	0.4	0.6
Croatia	0.4	8.2
Cyprus	0.3	29.4

Chart 3
Malta: Nominal trade levels for goods
(Exports and imports of goods in millions of $)



Source: IMF DOTS and author's calculations.

accelerating in the late 1990s. The process to remove levies accelerated from 1999 onward,[13] with successive actions in legal notices up to 2004.[14] As an example, levies on agro-industrial produce were removed slowly over a two year period, amounting to a cumulative reduction of 30% in the import levies by July 1, 2003. The remaining 70% were removed completely upon Malta's accession into the EU. Levies were removed as scheduled from January 1, 2004 onward. The same process occurred for different goods with different dates. On items such as furniture, levies were removed slowly over a two year period, such that all levies were removed by 2003.

[13]Legal Notice 123 of 1999.
[14]Legal Notice 344 of 2004.

4. Methodology

This study uses ordinary least squares (OLS), Poisson pseudo-maximum likelihood (PPML) methods, zero-inflated Poisson methodologies, and a Heckman estimator for robustness' sake. A number of attributes common in the gravity literature are included as regressors in the equation. These include partners' GDP level, and Malta's GDP, distance between Malta and its respective bilateral partner, population, partners' geographical size, common official language, common colonial background, as well as variables to account for Malta's membership in the EU (2004) and its association agreement with the EEC (1971).[15]

Poisson pseudo-maximum likelihood methods allow for the existence of zero-flows between two countries, and thus have a wider applicability to a good proportion of trade flows. Ignoring zero-flows may lead to wrong inference on coefficients included in the gravity equation. In Malta's case, this may be important given there are indications that its trade is highly focused towards a limited number of countries. In many cases, bilateral trade between Malta and other countries is non-existent.

Likewise, the truncation of zero-flows suggested the use of Heckman estimator techniques. These are suggested in the literature. An exactly identified version, an over identified version (using country landlocked status and fixed telephone subscriptions per 100 people),[16] and a two-step estimator were used, for the sake of estimation robustness.

The same methods were applied to nominal and real data. A further analysis of trade flows cleaned from the effects of trade in fuel oil, boats and aircraft for the years 2000 - 2016 was also carried out.

[15] The agreement was signed in December 1970, and took effect in April 1971. The dummy variable construction in annual terms was created for this agreement from 1971 onward.

[16] In this application, variables which affect the probability of a country engaging in trade with Malta but not the volume of the trade, have to be included in the equation.

Ordinary least squares methods

The first application of Newton's law of universal gravitation in physics to construct a gravity econometric model to study bilateral trade flows belongs to Tinbergen (1962). This model attempts to link bilateral trade flows between countries i and j with their respective gross domestic products (GDPs), geographical distance, and other factors affecting trade - such as common languages and cultural backgrounds (Anderson and van Wincoop, 2003). In the simplest form, following Santos Silva and Tenreyro (2006), the econometric model for stochastic gravity states that:

$$T_{ijt} = (K_0)\frac{M_{it}^{\beta 1} M_{jt}^{\beta 2}}{D_{ij}^{\beta 3}}\varepsilon_{ijt} \tag{1}$$

Where T_{ijt} is the bilateral trade flow between countries i and j in period t, M_{it} and M_{jt} are the GDPs of country i and country j in period t, respectively; D_{ij} is the bilateral distance between country i and j, K_0 is an unknown constant while $\beta 1$, $\beta 1$, and $\beta 3$ are unknown parameters. This basic equation is then augmented with other characteristics that affect bilateral trade, such as a common border, historic colonial ties, entry into regional trade agreements, and tariffs may be included as additional control variables. Eq. (1) is traditionally converted into linear form through logarithms, and estimated by ordinary least squares (OLS):

$$lnT_{ijt} = \alpha_0 + \beta_1 M_{it} + \beta_2 M_{jt} - \beta_3 lnD_{ij} + \epsilon_{ijt} \tag{2}$$

where $\alpha_0 = lnK_0$ and $\varepsilon_{ijt} = ln\epsilon_{ijt}$.

The gravity equations presented above are not based on micro-founded economic theory. However, since the late seventies, theoretical foundations for gravity models were developed

by Anderson (1979), Bergstrand (1985) and Deardorff (1998). More recent research, such as Anderson and van Wincoop (2003) hold that previous gravity equation specifications ignored multilateral resistance terms (MRTs). This can result in biased estimates. Anderson and van Wincoop (2003), starting from the constant elasticity of substitution function with unitary income elasticity, suggest that a theoretically grounded gravity model can be estimated as:

$$ln\frac{T_{ijt}}{M_{it}, M_{jt}} = \alpha_0 - \beta_3 lnD_{ij} + lnP_i^{1-\sigma} + lnP_j^{1-\sigma} + \epsilon_{ijt} \tag{3}$$

and $lnP_i^{1-\sigma} = \sum_j p_j^{\sigma-1}\theta_j e^{-\beta_3 lnD_{ij}}$ and $lnP_j^{1-\sigma} = \sum_i p_i^{\sigma-1}\theta_i e^{-\beta_3 lnD_{ij}}$.

Where $lnP_i^{1-\sigma}$ and $lnP_j^{1-\sigma}$ are the MRTs, σ refers to the elasticity of substitution between all goods, and θ_i and θ_j are the nominal income shares of countries i and j in global nominal incomes. The gravity model in Eq. (3) can be estimated using nonlinear or linear OLS with fixed effects as suggested by Anderson and van Wincoop (2003). Recent studies have questioned the inclusion of GDP in gravity equation, as it is external to the micro-founded theories (Disdier and Marette, 2010). A number of gravity models have thus begun to be estimated using OLS methods with time and country fixed effects:

$$lnT_{ijt} = \alpha_0 + \alpha_t + \alpha_i + \alpha_j - \beta_3 lnD_{ij} + \epsilon_{ijt} \tag{4}$$

where α_t, α_i and α_j are time fixed effects, as well as the fixed effects representing MRTs for trading partner i and j, respectively. Santos Silva and Tenreyro (2006) argue that the OLS estimation of log linear gravity in the above equations may be econometrically problematic; this is due in part to the presence of heteroscedastic errors, which would bias elasticity estimates because of Jensen's inequality. The second issue is that the log linear transformation of zero trade observations is problematic. Unfortunately, much of bilateral trade data contain a large number of zero trade observations. These tend to either be

dropped, or in some cases have a small positive number added to all trade observations for the log linear transformation to be feasible. Zero trade flows are rarely randomly distributed. Their truncation would lead to biased results. Similarly, adding small positive values to trade flows has no theoretical basis and will distort estimates (Flowerdew and Aitkin, 1982). Due to these problems, OLS methods may not yield consistent parameter estimates.

Poisson methods

Poisson methods in bilateral trade analysis were pioneered by Santos Silva and Tenreyro (2006). Faced with zero bilateral trade flows and heteroscedastic errors resulting from Jensen's inequality, they contend in favour of the multiplicative estimation of the gravity model using Poisson Pseudo Maximum Likelihood (PPML) estimations.

Burger et al. (2009) show how bilateral trade flows T_{ijt} between i and j in period t, has a Poisson distribution with a conditional mean defined as some matrix of bilateral and multilateral trade barriers. The probability mass function for countries i and j in period t, has a Poisson distribution with a conditional mean which is the function of a matrix of bilateral and multilateral trade barriers, and the probability mass function in the form of:

$$Pr[T_{ijt}] = \frac{e^{-\mu}\mu^{T_{ijt}}}{T_{ijt}!}, (T = 0, 1, 2...) \tag{5}$$

where $\mu = e^{(\alpha_0+\alpha_t+\alpha_i+\alpha_j-\beta_3 lnD_{ij})}$.

Poisson models assume equidispersion, that is, that the conditional variance should equal the conditional mean (Cameron and Trivedi, 2010). In most cases, this property is violated as the dependent variable of bilateral trade flows is overdispersed, meaning that the conditional variance exceeds the conditional mean. Overdispersion may lead to inefficient estimation in Poisson models. Negative binomial (NB) models are frequently employed to correct for

overdispersion (Burger et al., 2009). Probability mass functions of NBs are defined as:

$$Pr[T_{ijt}] = \frac{\Gamma(\alpha^{-1} + T_{ijt}}{T_{ijt}!\Gamma(\alpha^{-1})} \cdot \Big(\frac{\alpha^{-1}}{\alpha^{-1} + \mu}\Big)^{\alpha^{-1}} \cdot \Big(\frac{\mu}{\mu + \alpha^{-1}}\Big)^{T_{ijt}} \tag{6}$$

where Γ is the gamma function and α is the variance parameter of the gamma distribution. A likelihood ratio test on α can be used to test whether a negative binomial distribution is preferred over the Poisson distribution. Cameron and Trivedi (2010) state that the NB models are more general than Poisson models, as they account for over-dispersion and reduce to Poisson models as α approaches zero.

While numerically both the PPML and NB models are able to handle zero trade flows, they are not appropriate if the amount of observed zero values is higher than the number of zeroes predicted by the estimated model, Burger et al. (2009). Extensions to these approaches, called Zero Inflated Poisson (ZIP) and Zero Inflated Negative Binomial (ZINB) models can be used to overcome the encountered problems.

The zero inflated Poisson regression is made up of two parts. The first is a logit equation which models the probability of zero bilateral trade flows - that is having no trade at all - between countries. The second part takes up the bilateral trade flows, including zero trade values, as count data to estimate a Poisson model. The probability mass functions of the two parts of the zero inflated Poisson model are, respectively:

$$Pr[T_{ijt}] = \psi_{ij} + (1 - \psi_{ij})e^{-\mu} \text{ if } T_{ijt} = 0 \tag{7}$$

$$Pr[T_{ijt}] = (1 - \psi_{ij})\frac{e^{-\mu}\mu T_{ijt}}{T_{ijt}!} \text{ if } T_{ijt} > 0 \tag{8}$$

where ψ_{ij} refers to that proportion of observations in the sample ($0 \leq \psi_{ij} \leq 1$) with zero trade flows. It follows that when $\psi_{ij} = 0$ the ZIP model becomes identical to the Poisson model. With over-dispersion and zero inflated issues in the study sample, a zero-inflated negative binomial (ZINB) model can be constructed, following the ZIP model:

$$Pr[T_{ijt}] = \psi_{ij} + (1 - \psi_{ij})\Big(\frac{\alpha^{-1}}{\alpha^{-1} + \mu}\Big)^{\alpha^{-1}} \text{ if } T_{ijt} = 0 \tag{9}$$

$$Pr[T_{ijt}] = (1 - \psi_{ij})\frac{\Gamma(\alpha^{-1} + T_{ijt})}{T_{ijt}!\Gamma(\alpha^{-1})}.\Big(\frac{\alpha^{-1}}{\alpha^{-1} + \mu}\Big)^{\alpha^{-1}}.\Big(\frac{\mu}{\mu + \alpha^{-1}}\Big)^{T_{ijt}} \text{ if } T_{ijt} > 0 \tag{10}$$

ZIP and ZINB models allow an examination of the impact of trade barriers on both the probability of trade actually taking place (the intensive margin) as well as the volume of the trade taking place (the extensive margin). The ZIP and ZINB models are less sensitive to a breakdown in the normality and heteroscedasticity assumptions of the error terms. These models are appropriate to model bilateral trade flows with excess zero trade observations. The choice of an econometric model specification is based on a standard statistical test. As noted in a further analysis on Santos Silva and Tenreyro (2006),[17] both the negative-binomial and the zero-inflated regression models have a scale invariance problem in the dependent variable. That is, constructing a model of trade in euro or in thousands of euro leads to different estimates for the elasticities.

[17]See the discussion online, **here**.

The Heckman method

The Heckman method is an alternative specification of the gravity econometric model, which retains a log linear transformation, while treating zero trade values as censored observations. The gravity model specification will contain both censored and uncensored observations:

$$Y^*_{ijt} = \alpha_0 + \alpha_t + \alpha_i + \alpha_j - \delta_3 lnD_{ij} + u_{ijt} \tag{11}$$

$$lnT^*_{ijt} = \alpha_0 + \alpha_t + \alpha_i + \alpha_j - \beta_3 lnD_{ij} + \epsilon_{ijt} \tag{12}$$

where Y^*_{ijt} is a latent variable controlling whether or not bilateral trade between two countries i and j in the sample is observed, and lnT^*_{ijt} logarithm of the volume of bilateral trade. u_{ijt} is the error term associated with the selection process. Y^*_{ijt} is not observed in the selection equation, and neither is the logarithm of the volume of trade lnT^*_{ijt} in the outcome equation. The variables which are observed will depend on the state of the latent variable: If $Y^*_{ijt} > 0$ then $Y_{ijt} = 1$; if $Y^*_{ijt} \leq 0$, then $Y_{ijt} = 0$. If $Y^*_{ijt} \geq 0$, then $lnT_{ijt} = lnT^*_{ijt}$. lnT_{ijt} will not be observed if $Y^*_{ijt} \leq 0$. The selection equation is used to incorporate the binary decision whether or not to trade based upon latent profitability. An outcome equation determines the intensity of bilateral trade. The Heckman model requires that error terms in (11) and (12) have a bivariate normal distribution with zero means, standard deviation σ_u and σ_ϵ and correlation ρ such that:

$$\begin{bmatrix} u_{ijt} \\ \epsilon_{ijt} \end{bmatrix} \sim N \left\{ \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \rho\sigma_u\sigma_\epsilon \\ \rho\sigma_\epsilon\sigma_u & \sigma^2_\epsilon \end{bmatrix} \right\}$$

The model is estimated either by using the two-step procedure suggested by Heckman (1979) or following one-step maximum likelihood estimation. The one-step approach estimates the selection and outcome equation simultaneously. The two-step procedure first estimates the bivariate selection equation using probit, and then generates the inverse of the Mills ratio:

$$\lambda(\alpha_u) = \frac{\phi(\frac{\alpha_0+\alpha_t+\alpha_i+\alpha_j-\beta_3 lnD_{ij}}{\sigma_u})}{\Phi(\frac{\alpha_0+\alpha_t+\alpha_i+\alpha_j-\beta_3 lnD_{ij}}{\sigma_u})}$$

where ϕ and Φ are the standard normal density function and the cumulative distribution function, respectively. The variable $\lambda(\alpha_u)$ is then included as an additional regressor, allowing the parameters of the outcome equation to be estimated consistently using OLS methods.

The Heckman approach has the advantage that it can deal effectively with zero trade observations. It allows researchers to discriminate between the impact of bilateral barriers on the extensive, as well as the intensive trade margins (Cipollina et al., 2010). The one-step maximum estimation empirically appears to give better results than the two-step Heckman estimator (Puhani, 2000). Monte Carlo simulations also confirm this finding (Martin and Pham, 2008) - if, however, one is able to find the true restricted variables. With large datasets, however, the full maximum likelihood approach may be computationally difficult. In that case, the Heckman two-step estimation is considered the best approach, following Helpman et al., (2008), and Wooldridge, (2002).

5. Results

Results in nominal terms

Results indicate that, on average, for every 10.0% increase in distance, exports and imports fall by 11.1% and 7.5% respectively, on average across the methodologies (see Table 2).[18] These estimates are common the gravity literature. It is apparent that sharing common cultural ties are important to trade. One may theorise that a number of countries with common cultural backgrounds feature on the same global value chain. While countries with a common colonial history feature on the export side, countries with English as an official language feature strongly on the import side. Malta shares a common cultural and historical background with a number of Anglophone countries. This may enhance Malta's imports from the United Kingdom and Ireland. Moreover, sharing similar tastes and habits may strengthen trade flows. Implicitly, these characteristics are captured in these variables, acting as proxies for culture, institutions and tastes.

Countries with a common colonial background as Malta are seen, on average, 135.5% more likely to trade with Malta on the export side. On the import side, this variable was insignificant. Moreover, Malta is 186.4% more likely to import goods from countries with a common language, another indicator of cultural ties. This indicator was insignificant on the export side. Common colonial backgrounds (export side) returned higher effects prior to Malta's membership of the EU in 2004, with the likelihood being, on average, 195.3% higher. Having a common language (import side), increased the likelihood of imports by 114.7% for the years 1960 - 2003. The latter may be due to heightened trade with the United Kingdom and Ireland upon EU entry, as well as other Anglophone countries trading with the EU. The former may reflect structural change by Maltese exporters in labour intensive markets following EU membership.

[18] Semi-elasticities are calculated via estimated coefficients β of the variable of interest, converted into percentage terms such that $(e^{\beta-1}) * 100$. This follows Hoffman and Kassouf (2005).

Table 2: Results in nominal terms, for both the full and restricted period.

Exports		OLS	PPML	HECKMAN (Exact id.)	HECKMAN (Over id.)	HECKMAN (2-step)	Average
1960 - 2016	Distance (elas.)	**-1.1 *****	**-0.7 ****	**-1.2 *****	**-1.2 *****	**-1.4 *****	-1.1
% more likely to trade							
	Common language	59.2 *	-	-	-	**68.6 *****	63.9
	Common colony	**109.6 ****	**148.6 ****	**130.9 *****	**124.3 ****	**164.1 *****	135.5
1960 - 2003	Distance (elas.)	**-1.2 *****	**-1.0 *****	**-1.4 *****	**-1.3 *****	**-1.6 *****	-1.3
% more likely to trade							
	Common language	-	**82.6 ****	-	-	**65.4 *****	74.0
	Common colony	**142.4 *****	**255.6** **	**178.8 *****	**167.6 *****	**231.9 *****	195.3
Imports							
1960 - 2016	Distance (elas.)	**-0.6 *****	**-1.1 *****	**-0.7 *****	**-0.7 *****	**-0.7 *****	-0.7
% more likely to trade							
	Common language	**158.5 *****	-	**163.6 *****	**160.2 *****	**263.4 *****	186.4
	Common colony	-	**148.6 ****	-	-	**71.9 *****	110.2
1960 - 2003	Distance (elas.)	**-0.6 *****	**-1.1 *****	**-0.6 *****	**-0.6 *****	**-0.6 *****	-0.7
% more likely to trade							
	Common language	**142.4 *****	**91.3 *****	**113.9 ****	**110.2 ****	**115.7 *****	114.7
	Common colony	-	-	-	-	-	-

*** Significant at the 10% level**
** **Significant at the 5% level**
*** **Significant at the 1% level**

Table 3: Results in nominal terms, focusing on the trade agreements.

Exports		OLS	PPML	HECKMAN (Exact id.)	HECKMAN (Over id.)	HECKMAN (2-step)	Average
	MT EC Agreement	**137.1 ****	-	**135.7 ****	**136.9 ****	**134.4 *****	136.0
	MT EU Membership	-	-	-	-	-	-
Imports							
	MT EC Agreement	**112.6 ****	-	**108.6 ****	**111.1 ****	**108.3 *****	110.1
	MT EU Membership	**448.8 *****	-	**437.6** ***	**445.1 *****	**437.9 *****	442.3

*** Significant at the 10% level**
** **Significant at the 5% level**
*** **Significant at the 1% level**

Table 4: Results for the restricted dataset cleaned from volatile trade components. (Fuels, ships, aircraft).

		OLS	PPML	HECKMAN (Exact id.)	HECKMAN (Over id.)	HECKMAN (2-step)
Exports						
2000 - 2017	Distance (elas.)	**-0.9 *****	**-0.9 *****	**-1.0 *****	**-0.9 *****	**-1.1 *****
% more likely to trade						
	Common language	-	**65.3 ****	-	-	**71.6 *****
	Common colony	87.5 *	**115.9 *****	**102.7 ****	59.0 *	**123.1 *****
Imports						
2000 - 2017	Distance (elas.)	**-0.9 *****	**-1.0 *****	**-0.9 *****	**-0.9 *****	**-0.9 *****
% more likely to trade						
	Common language	**209.8 ****	-	**206.0 *****	**208.6 *****	-
	Common colony	-	-	-	-	**33.7 *****

* **Significant at the 10% level**
** **Significant at the 5% level**
*** **Significant at the 1% level**

A statistically significant and positive impact was found for both exports and imports between Malta and the EEC following the Association Agreement in 1970. On average, across the methodologies employed, the agreement increased the likelihood of exports by 136.0% and that of imports by 110.1% (see Table 3). EU membership, however, only returned significant impact on goods imports. EU membership made it, on average, 442.3% more likely for Malta to import from EU countries rather than from outside the Union.

The lack of significance of EU membership on goods exports may reflect the fact that Malta was already integrated with the EU on the export side following the 1970 Association Agreement. Additionally, manufacturing in Malta passed through a period of structural change following EU membership, while EU membership's impact on services is excluded. Moreover, the significantly higher estimate for goods imports may indicate a shift towards EU sourced imports following the imposition of barriers to trade outside the EU, and the removal of Maltese barriers to import from the EU. Poisson pseudo-maximum likelihood methods, which allow for zero-flows between two countries, return insignificant values for many attributes included in the gravity equation. However, this may be due to data over-dispersion.

Table 5: Results in real terms, focusing on the trade agreements.

		OLS	PPML	ZIP	HECKMAN (Exact id.)	HECKMAN (Over id.)	HECKMAN (2-step)	Average
Exports	MT EC Agreement	**1033.3 *****	**520.8 *****	**1081.1 *****	**943.8 *****	**2222.2 *****	**918.8 *****	1120.0
	MT EU Membership	**662.7 *****	-	-	**247.2 *****	**379.9 *****	**230.9 *****	380.2
Imports	MT EC Agreement	**2218.9 *****	**247.6 *****	**775.9 *****	**1747.3 *****	**3655.3 *****	**1342.3 *****	1664.5
	MT EU Membership	**3624.0 *****	**284.8 *****	-	**2061.3 *****	**3478.0 *****	**1701.4 *****	2229.9

*** Significant at the 10% level**
**** Significant at the 5% level**
***** Significant at the 1% level**

Subsidiary gravity equations based on total trade flows cleaned from trade in fuel, aircraft and ships were estimated for the period 2000 to 2017, to serve as a robustness check.[19] Data is sourced from an alternate EUROSTAT dataset. The results are very close to the previous estimates in most cases, except for the variables accounting for institutional and cultural backgrounds (see Table 4).[20] Once these specific trade sectors are excluded, the likelihood of importing from common colonies becomes broadly insignificant. This might also be the impact of the reduced flows and the reduced time period as well. One could argue that these coefficients may be impacted by the introduction of EU trade barriers affecting these former common colonial trade partners from 2004 onward.

Results - in real terms

As noted above, trade in goods is described in the literature as a 'real' phenomenon. By excluding the price factor and focusing on nominal values rather than real volumes, one would risk biasing the results due to price changes. The same equations and estimates carried out

[19] The ZIP method could not be run over the shorter time period 2000 - 2017.

[20] Results of this robustness check change with the exclusion of semiconductors. This indicates that other factors may be at play for specific sectors or firms. This is particularly the case for Malta due to the relative sizes of trade flows. These will determine a particular trade direction. In this particular case, being part of a global value chain and being involved in the production of a unique product with limited global competition, may negate the common cultural factors (like colonial background) which are considered by the paper. These may not be so relevant for certain firms. In this case, this particular firm accounts for a sizeable share of exports and imports. However, it appears that the inclusion of the full sample (i.e. since the 1960's) does not affect the result. This may suggest significant structural changes in this sector/firm during the years.

above were again estimated using real values.[21]

The results are, again, striking - and confirm the importance of trade as a pillar of Maltese economic growth. Using the data in Grech (2015), in real national accounts terms, total real exports of goods and services in Malta grew by 2,055% between 1960 and 2016. Total real imports grew by 1,238%. On the export side, the results show positive and significant results with the magnitudes of the coefficients above 1.0 for the MT-EEC Agreement dummy variable, with the coefficient resting between 1.8 and 3.1 between different methodologies (see Table 5). For the import side, the coefficient on the MT-EEC Agreement also returns positive and significant results - resting between 1.3 and 3.6.

The magnitudes and the significance suggest that the EEC countries were both a significant destination of Maltese exports, as well as a source of imports. The EU accession dummy variable has a positive and significant coefficient in models on the export side, and a significant and positive coefficient on the import side. The ranges of the estimates on the export side, however, are lower than those for the MT-EEC Agreement.

Conversely, the magnitudes of the EU dummy variable coefficients on the import side are greater than those for the MT-EEC Agreement dummy variables. Using the deflated data for Maltese trade flows in the gravity model, the Association Agreement made it - on average across the methodologies - around 1,120% more likely for Malta to export towards a country which was part of the then-EEC. Likewise, Malta's membership in the EU increased the likelihood of exports towards the EU - on average - by around 335%. The use of national accounts deflators to deflate customs trade data forces a careful interpretation of these figures. Particular caution ought to be taken with the measured absolute level effects, and the disparity between the methods employed. In particular, overdispersion may be causing PPML to return inefficient results - which are corrected for in ZIP and Heckman methods.

[21] Results for ZIP estimations are carried out for the period 1960 - 2000. Implicitly, this excludes the possibility of including an analysis on Malta's EU membership.

The most important stylised fact from this analysis, however, is that the Association Agreement is estimated to have had three times as strong an effect on real goods exports than Malta's EU accession. The relative impact of the two is strongly tilted towards the 1970 agreement for exports.

At least in more recent years, the impact of price changes has had a significant effect on the interpretation of Malta's nominal trade flows. As noted in Grech (2015), the vast majority of the increase in exports of goods between 2003 and 2014 was generated by re-exports of fuel. A substantial part of these large movements is seen to be linked with price changes.

For imports, the Association Agreement made it - on average across the methodologies - around 1,840% more likely for Malta to import from a country which was part of the then-EEC. Malta's accession to the EU increased the probability of imports from the EU by around 2,230%. While noting the same caveats in the interpretation due to the price indices, it is apparent that Malta's EU accession in 2004 had a larger impact on imports than the Association Agreement. This confirms that the 1970 Agreement opened up European markets for Maltese exports, while Malta retained its import controls. This Agreement therefore had a stronger impact on exports than on imports. Accession to the EU meant that by 2004 these restrictions were all removed, leading to a stronger impact on imports. Moreover, one can also theorise that the latter change had a larger impact on services than on goods - and these are excluded from the framework of this analysis. The effect on the import side, however, is not as strongly skewed towards the 2004 EU accession, as the 1970 Association Agreement is on the export side. This may also result from the gradual removal of import duties and levies, a process which began as early as 1999.

Turning to distance, a 10.0% increase in distance is seen to decrease real exports by 6.9%, on average, across the methodologies. Likewise, a 10.0% increase in distance is seen to decrease real imports by 5.5% (See Table 6).

Table 6: Results in real terms, focusing on the distance.

		OLS	PPML	ZIP	HECKMAN (Exact id.)	HECKMAN (Over id.)	HECKMAN (2-step)	Average
Exports	Distance (elas.)	**-0.9 *****	-	-	**-0.5 *****	**-0.9 *****	**-0.5 *****	-0.7
Imports	Distance (elas.)	**-0.5 ****	**-0.9 *****	**-0.8 *****	-0.3 *	**-0.5 ****	**-0.3 *****	-0.6

*** Significant at the 10% level**
**** Significant at the 5% level**
***** Significant at the 1% level**

Moreover, once deflated, the coefficients for common language and common colonial histories were all insignificant. This may mean that either the effects noted in the nominal equations were misleading due to the lack of a pricing dimension, or that the deflators used in this part of the analysis are imperfect, at least for the regressors relating to cultural background.

Finally, one must note that over the roughly 50 years analysed in this paper, Malta has experienced periods of very strong structural change, a history marked by a trade driven economic success story. This leads to particular data volatility which has to be highlighted, along with other limitations of this study. The use of customs data is affected by particular trade phenomena, such as the re-export of fuel oils by Maltese bunkering operators, and highly integrated firm specific value-chain trade. Such value chains may negate established norms in gravity modelling, such as distance. Attempts are made to find goods export and import flows by country and good sector. This data, however, is only available for the years 1999 - 2016. This in itself limits the usefulness and significance of the study. Moreover, services flows are, by their very definition, excluded from this analysis. The services sector may have experienced a different outcome to the manufacturing industry following EU accession. Finally, the imperfect measuring of price indices is also a caveat for the analysis of real trade flows.

6. Conclusions

The objective of this study of trade flows in Malta is to examine the effectiveness of the gravity model specification for a small open economy like Malta, to test a number of hypotheses on the country's history of trade agreements and assess the distribution of export and import flows in Malta's trade relationship.

The main results are that Maltese trade is affected by distance, along with a set of other variables which account for incomes and culture. While data limitations and breaks in time series have to be considered, the estimates indicate that when corrected for variables such as country distance, country size and population size, the 1970 EEC-Malta Association Agreement had a stronger impact on goods exports than Malta's entry in the EU in 2004, and that Malta's entry in the EU had a strong impact on goods imports from EU countries.

Malta's economic progress appears to have benefitted from these agreements. The very strong rates of export growth registered over the past decades are indicative of a complete structural change in the fabric of the Maltese economy between 1960 and 2016. This change was facilitated by the trade agreements, and by the related policy changes implemented so that operators could benefit from these agreements.

While the story behind the numbers for trade in goods may now be blurred by the relatively stronger success in services (an area for potential future research), the estimates presented here show that economic development in Malta comes arm-in-arm with positive international trade relations.

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8. Appendix

An appendix including the whole set of regressions carried out in this study may be shared by the author, upon request.