ASSESSING THE IMPACT OF ACCESSION TO THE WORLD TRADE ORGANISATION (WTO) ON MEMBER TRADE: EVIDENCE FROM 1960-2020

by

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8100 Words

I certify that this project is all my own work.

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Abstract

The debate on the benefits of membership to the General Agreement on Tariffs and Trade (GATT), and its successor, the World Trade Organisation (WTO) is far from concrete. With the recent rise of strongman politicians that detest international institutions, there is a need to measure the contemporary effects of membership to reaffirm their benefits.

This study quantitatively measures the effect GATT/WTO membership has had on bilateral trade. Using a Poisson pseudo-maximum-likelihood-high-dimensional-fixed-effects (PPMLHDFE) model using IMF bilateral trade data from 1960 to 2020, evidence suggests that a pair of members trade 62% more than a pair of non-members. Furthermore, a country pair with only one member trade 34% more than a pair of non-members. These results are consistent with literature that similarly found positive membership effects.

Additionally, evidence suggests that the membership trade effects for developing countries was marginally stronger for those that accessioned after 1995. The results highlight the significance of committing to obligations during the accession process.

1.1: Introduction

The 20th century saw a general increase in global cooperation with the rise of international institutions. These institutions arose through a global desire for peace and cooperation after the Second World War. The League of Nations, the first significant international institution that was formed in the wake of the First World War to maintain global peace, was marred by a lack of influential powers and a failure to prevent rising

tensions globally. By comparison, the institutions that arose following the end of the Second World War have been more successful in fulfilling their objectives.

A number of these international institutions are economic in nature, as their founders recognised the significance of the Great Depression played in the rise of Nazi Germany. The International Monetary Fund (IMF), formed in 1944, promoted economic cooperation between nations and provided monetary stability by acting as an independent lender. The World Bank, also formed in 1944, offered a similar service to the IMF by providing financial support to struggling countries.

The General Agreement on Tariffs and Trade (GATT), was formed in 1948 to specifically promote international trade and prevent the rise of international protectionism that plagued the global economies in the 1930s (Irwin 1995).

While successful in preventing a backslide towards raising tariffs in the post-war world, the GATT was later succeeded by the World Trade Organisation (WTO) in the 1995 Uruguay Round to address a number of challenges that had arisen in the latter half of the 20th century.

The WTO promotes international trade in many ways, such as through hosting international platforms for trade negotiations, improving the predictability of trade patterns, and providing technical assistance for developing nations. However, its core purpose is to reduce tariffs and other barriers to trade, such as quotas, through a process called “reciprocal liberalisation” (Irwin 1995).

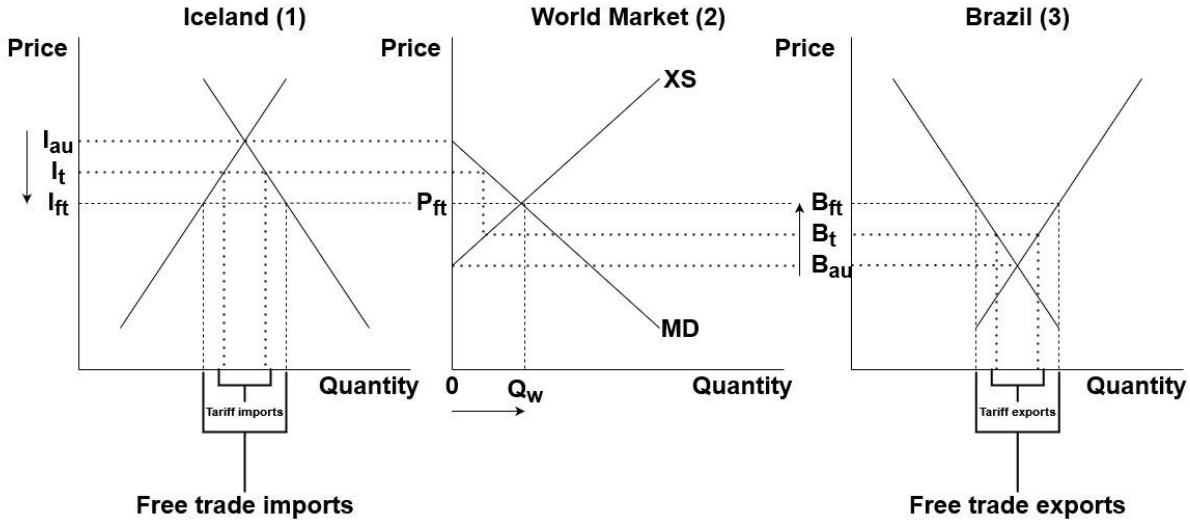
Reciprocal liberalisation is defined as an agreement between two or more countries to reduce their trade barriers for a particular good or industry. This process is core to the WTO’s authority as an international institution, as countries may feel more secure that they won’t be “cheated” by their trade partner should they renege on their agreement to

liberalise, because of the WTOs ability to issue sanctions and penalties on those that break agreements (Bagwell and Staiger 1999).

1.2: Tariff theory

It is a fundamental truth in economics that reducing the cost of something increases its demand. The same is true for trade; by reducing the cost of exchanging goods, there is a direct increase in the amount of trade. This fact is illustrated below, on Graph 1:

Graph 1



Graph 1 illustrates two economies, Iceland and Brazil. Iceland, the domestic case, cannot produce much of a particular good, for example coffee. In autarky, where no trade exists between Iceland and other countries, the Icelandic autarky price of coffee is given by I_{au} (1). For any price below I_{au} there is *excess demand* for coffee. The domestic supply of coffee cannot meet domestic demand at these prices and as such the import demand curve, MD, is created on the world market (2).

By comparison, Brazil has a comparative advantage in coffee production: it has the perfect climate and a large amount of land and people to produce lots of it. Because of

their ample supply, the Brazilian autarky price of coffee is given by B_{au} (3). Prices above B_{au} create *excess supply*, denoted by the XS curve on the world market (2).

Where the XS and MD curve intersect is where the price on the world market, or "free trade price" of coffee is found.

As the Icelandic economy moves from autarky to importing coffee with tariffs, equal to t, both the Icelandic and Brazilian prices converge slightly towards the free trade price of coffee, shown by the movement of I_{au} down to I_t (1), and B_{au} up to B_t (3).

Additionally, if the Icelandic economy removes all trade barriers on coffee, t, both the Icelandic and Brazilian prices will converge to the same free trade price, P_{ft} (3). Further still, both economies will be importing and exporting to a greater degree compared to trade with tariffs.

Graph 1 illustrates this process, as trade barriers are removed between economies, economies engage more in trade shown by the expansion in the quantity of goods traded from 0 to Q_w on the world market (2).

Consequently, this expands the consumption capabilities of the importer, Iceland, and give the exporter, Brazil, a wider market to sell their goods to.

1.3: Problem

While both theory and conventional wisdom holds that an institution such as the GATT/WTO, whose sole purpose is to promote trade by reducing barriers would be successful in doing so given its longevity, there remains ample confusion regarding the institutions ability to actually increase trade for its members.

This confusion stems from two sources: Firstly, ‘GATT pessimists’ who have tried to answer this question in the past and used flawed methodologies, which result in biased evidence that suggests membership does not have a statistically significant effect on trade. The second source is more nefarious; with the rise of strongman politics in the previous two decades, demagogues globally have exploited people’s scepticism with international institutions to try and undermine the rules and regulations to which they are expected to adhere (Rachman 2022). Jawara and Kwa (2004) describe the WTO as a neo-colonial institution run by the ‘global elites’ that coerce developing countries to adopt policies they profoundly disagree with. On the other side of the same coin Republican nominee Donald Trump threatened to pull the United States out of the WTO during his 2016 election campaign, describing the institution as a “disaster [for USA trade]” (Dyer, 2016).

This begs the question: To what extend does GATT/WTO membership increase countries trade?

2.1: Literature review introduction

This is the literature review of the study, which will discuss a brief history and purpose of the GATT, and the modern functions of the WTO,

2.2: History and theory of the GATT/WTO

The GATT/WTO is an international institution that promotes free and open trade between countries.

The Generalised Agreement on Tariffs and Trade (GATT) was established in 1948 to prevent the same post-war economic slowdown witnessed during the interwar period by reducing trade barriers and discriminatory trade policies. The architects behind the GATT recognised that trade liberalisation, specifically reciprocal tariff reductions between countries, played a key role in obtaining desirable economic goals, such as monetary stability, fully employment, and a deterrence to deter the rise in communism (Irwin 1995; Gowa and Kim 2005).

The GATT stabilised global trade, and consequently, global economic output. This is in contrast to the interwar period, where the Great Depression disrupted global trade through protectionism (Eichengreen and Irwin, 2010), which meant countries consumption capabilities became more limited and markets to sell goods narrowed. This is visually described below, note the correlation between exports and output for both periods:

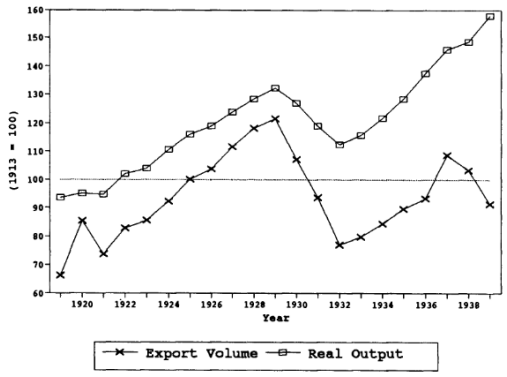


FIGURE 2. INTERWAR TRADE AND OUTPUT

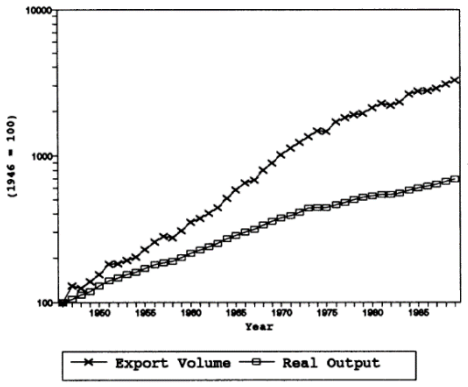


FIGURE 3. POST-WORLD WAR II TRADE AND OUTPUT

(Source: Irwin 1995, pp. 324-326[1])

A clear achievement of the GATT's ability to promote reciprocal liberalisation is demonstrated in how tariffs between industrialised countries fell by 36%, from 40% to less than 4% over the GATT's lifetime (Irwin 1995; Subramanian and Wei 2007). The

[1] Copyright American Economic Association; reproduced with permission of the American Economic Review

modern WTO, succeeding the GATT, is a similar trade liberalising institution. Its primary purpose is the promotion and facilitation of trade between countries. It does this by mediating between parties on trade disputes and by hosting a public forum for global stakeholders to discuss and transfer knowledge about trade.

Bagwell and Staiger (1999) created a theoretical framework to describe why countries might want to join the GATT, and what governments gain from joining such institutions. Governments sign trade agreements because they yield greater welfare. This is because they correct the inefficient tariff's set by governments that are motivated to maximise national income. However, Bagwell and Staiger's framework suggests this welfare gain is not uniform across countries. They find that a small country, defined as being unable to change world prices by implementing domestic tariffs, can do no better with a trade agreement than without one. In contrast, they find large countries can experience welfare gain through trade agreements due to the prisoner's dilemma that's created through tariff increases. As such, large countries are only motivated to liberalise if they think their counterpart country won't "cheat" and raise tariffs in a later period. In turn, Bagwell and Staiger's (1999) gives a theoretical explanation for why large countries, typically, engage in reciprocal liberalisation when joining the GATT, an institutional organisation that can prevent cheating through laws and regulations.

2.3: Log-linear gravity models

If the GATT/WTO can successfully incentivise members to engage in reciprocal liberalisation, then its logical that it should also increase bilateral trade. However, the debate on the positive effects of membership is far more contentions than one would

initially suspect. While the theoretical aspect of the benefits of WTO membership are described by Irwin 1995, and Bagwell and Staiger 1999, the evidence is less conclusive.

Rose (2004) was one of the first academic studies that tried to measure the quantitative effects of GATT membership, and his findings aroused scepticism in the institution's ability to promote trade. Rose used a log-linear gravity model (heron LLGM) to measure the effect GATT membership had on countrie's average bilateral trade. The study's findings suggested that GATT membership only promoted trade to a very small degree, and that membership was not statistically significant. Rose suggests that the lack of positive or significant results could be because developing members were not legally required to engage in liberalisation to the same degree that industrial countries were.

Rose's paper generated considerable discussion among international trade economists, and it spurred the investigation of the trade effects of the GATT/WTO for years after it was published. Academics that followed to evaluate Rose's findings use a similar methodology and the same data as him.

Despite Rose's influence in starting the debate regarding the quantitative effects of WTO membership, his paper contains a myriad of shortcomings regarding his data and methodology.

Tomz, Goldstine, and Rivers (2007) run a replica of the LLGM that Rose used, but correct a number of issues in the way countries where categorised. Rose marked countries that were colonies, de facto members and provisional members, as non-members. This is an issue because all three did have rights and obligations to the GATT. By correcting this misspecification, Tomz et al found that membership had substantially

promoted trade to a statistically significant degree, and suggested that Rose's misspecification created a significant negative bias in his data.

Subramian and Wei (2007) also use Rose's paper as the basis for their investigation on the trade effects of the GATT/WTO. Like Tomz et al, Subramian and Wei correct mistakes in Rose's analysis. However, they instead focus on the methodology used by Rose (2004). Subramian and Wei still use a LLGM regression but are more particular about the dependant variable of their model. They assert that the use of average bilateral trade between two countries is inconsistent with the theory underlying the gravity model. Further, they include additional control variables to measure multilateral resistance, which have been described as critical components in correcting misspecification s in the original Tinbergen gravity model (Anderson and Van Wincoop 2003).

Subramian and Wei (2007), using log-imports of country pairs, find that GATT/WTO membership had a very strong, but asymmetric effect on country trade. This imbalance happens between industrialised and developing countries. It echoes Rose (2004), in that developing nations weren't legally bound to participate in liberalisation, and thus their trade effects would be weaker. The strength of Subramanian and Wei's work lies in their meticulous reconstruction of the typical gravity regression model, which in turn led to results that were more consistent with the underlying theory behind the gravity model. This brought a new dimension to the discourse about the trade impacts of the GATT/WTO, specifically regarding developing countries that accessioned before 1995 and weren't required to liberalise significantly, and those that accessioned after 1995 and were obligated to liberalise.

Bagwell and Staiger's (1999) theoretical disparity between small and large countries is also echoed by the evidence gathered by Gowa and Kim (2005), who investigate the trade effects of GATT. Using a gravity regression model, they found that membership only promoted trade in a small handful of large, industrialised countries. Notably, Gown and Kim don't include any country fixed effects in their regression, choosing only to keep dyadic, or country pair fixed effects. They justify this by describing how difficult country fixed effects can be to measure, and how there is apparently little statistical difference between estimates that use country and country pair fixed effects.

2.4: Alternatives to log-linear gravity regression models

The use of gravity regression models is common and widely accepted in studies about the effects of GATT/WTO membership. However, several studies have used novel methodologies that differ from the LLGM described by Rose (2004) and Subramian and Wei (2007), and have found results that are both conflicting and consistent with earlier findings.

Silva and Tenreyro (2006) argues that because trade data is typically heteroskedastic (meaning the variance of a variable's error terms are inconsistent), including it in LLGM regressions is in violation of the underlying assumptions of Ordinary Least Square (OLS) regressions. OLS regressions assume homoscedasticity, which means the variance of their error terms are constant. As such, they argue that this makes the results of such regressions less statistically reliable.

Silva and Tenreyro (2006) also conduct a RESET test to compare correct model specifications between the OLS and Poisson gravity models. The results of this test suggested that the log-linear regression model was inappropriately specified, but that

the Poisson model was not. Thus, Silva and Tenreyro favour the Poisson regression over OLS for gravity model estimations.

Liu (2009) extends Silva and Tenreyro's theory to measure country pair imports under GATT/WTO membership. Using a Poisson regression, Liu estimates that the GATT/WTO had a strongly significant trade promotion effect between existing trade partners, called intensive margin, as well as a strongly significant effect at creating new trading relationships, called extensive margin.

Poisson regressions detect more muted effects of trade agreements compared to standard OLS regressions. As such this may indicate standard log-linear regression results in substantial bias. However, this may be due to Liu (2009) not differentiating between industrial and developing countries, which may have resulted in a downward bias in his estimation given developing member's exception from liberalisation prior to 1995.

Cho and Zheng (2021) develop a Bayesian gravity model to estimate the effects GATT/WTO membership has on bilateral trade. Cho and Zheng use the same dataset as Liu (2009) but found conflicting results. They determined that GATT/WTO membership did not have a statistically strong effect on trade flow. A key factor of Bayesian estimations is the strength of belief regarding the relationship in question; Cho and Zheng state in their analysis they have very vague beliefs about prior values. Regardless, Cho and Zheng describe their model as fitting the aggregate data better than other models when measured in mean squared error of prediction (MSEP), and they highlight the importance of including a lagged dependant variable in gravity model estimations.

2.5: The significance of the Uruguay Round

A much talked about topic in the debate about the GATT/WTO's trade promoting abilities is the fact that, prior to the Uruguay Round in 1995 and the transformation into the WTO, the GATT allowed developing nations to accession without engaging in liberalisation to the same degree compared to industrialised countries. The evidence of this is presented in Table 1, which compares accessioned developing countries before and after 1995 on the tariff commitments made (Subramanian and Wei 2007).

Table 1

% of accessioned developing countries that:

	Before 1995	After 1995
Bound tariffs in the industrial sector	58%	94%
Set bound tariffs much higher in the industrial sector	33%	17%
Set bound tariffs much higher in the agricultural sector	63%	28%

(Source: Subramanian and Wei 2007)

Few studies have examined pre-post Uruguay Round disparity in much detail relative to the number of studies focused on the broad effects of GATT/WTO membership. Subramian and Wei (2007) use yearly dummies between 1990 to 1995, in addition to 2000 to test if accessioning developing country's trade data were statistically different from developing accessioned countries from before 1990. They state that countries that accessioned in the early 1990s experienced no significant increase in trade by 1995, but that by 2000 they had done so. Further, Subramian and Wei found that "old" developing countries, those that accessioned in the early 1990s, trade remained statistically

insignificant, even after 1995, suggesting the limits of the Uruguay Round to impact existing developing member's trade policies.

Tang and Wei (2009) conduct an event study analysis to specifically quantify the effect accession to the GATT/WTO has on economic growth. Additionally, they compare countries that accessioned under Article XXVI, an agreement for previous colonies of current GATT members to accession in 1994 with no obligations to liberalise, to developing countries that accessioned post 1995. Tang and Wei find that GATT/WTO accession was strongly and significantly associated with increases in economic growth for countries that did not accession under Article XXVI, but they did not find evidence of a strong, significant relationship if countries accessioned with no obligations. Tang and Wei's findings contrast to Subramian and Wei's (2007) findings, who found evidence that countries that accessioned in the early 1990s, which includes countries under Article XXVI, did experience significantly positive growth by 2000.

Both studies are limited that their scope only extend to 5 and 8 years after the WTO formation respectively. Brotto, Jakubik, and Piermartini (2021) extended Tang and Wei's methodology to 2020 and includes an additional 37 countries that accessioned under the WTOs Article XII. They found comparatively stronger economic growth effects to Tang and Wei (2009), which they theorise is because of the stronger liberalising effect of Article XII.

2.6: Literature review conclusion

The literature on the trade effects of the GATT/WTO is extensive. This is in part due to Rose (2004), who found evidence that contrasted with what economists assumed to be obvious: that membership of an international organisation solely dedicated to promoting

trade, would be able to promote trade. Numerous studies followed that refined Rose's (2004) method, some of which used new and novel approaches to help answer questions about membership and trade.

While the consensus on the GATT/WTO has become more uniform in recent years, there still exist conflicting results in recent studies which keep the topic hotly debated. One strand of studies, Silva and Tenreyro (2006) and Liu (2009), which utilise Poisson regressions rather than the standard LLGMs, are of particular interest to this study.

3.1: Methodology introduction

This section introduces the methodology adopted to answer how accession to the GATT/WTO impacts developing country's trade. The study extends the findings of Liu (2009) from the years of 1948-2003, to 1960-2020.

This section also describes the gravity model, why the Poisson gravity model is superior to the more common log-linear gravity model, and the chosen variables which are used in this study.

3.2: Gravity model

The gravity model was first specified by Ravenstein (1889) to estimate migration patterns in Victorian Britian, and has since been adopted by Tinbergen (1963) to explain trade flows. The gravity model has since become a staple equation in trade literature. It predicts trade between two countries, T_{jk} is proportional to the mass of their respective GDPs, $Y_j Y_k$ (hence the Newtonian reference), their distance and other relative frictions, D_{jk};

$$T_{jk} = \alpha \frac{Y_j Y_k}{D_{jk}}$$

The gravity model is widely used because of its high explanatory power in describing patterns of trade, as well as for its simplicity. There have been extensions of the gravity model that Tinbergen described to better capture the complexities of global trade patterns. Anderson and Van-Wincoop (2003) described the original model as misspecified, and corrected it by including measures of remoteness, defined as the distance of two countries compared to the rest of the world weighted by all other countries GDPs (Anderson 2011).

3.3: OLS issues

While log-linear OLS regressions are common in the literature described in Section 2.3, Silva and Tenreyro (2006) describe two key reasons why the Poisson pseudo-maximum-likelihood (PPML) approach is preferable to OLS regressions for studying gravity models:

1. The presence of zero trade data
2. Implied presence of heteroskedasticity

Firstly, there are instances where countries observe zero bilateral trade data. Haveman and Hummels (2004) find that a third of their country pair samples do not trade with each other. Helpman, Melitz and Rubinstein (2008) find nearly half of their pairs don't trade. The existence of substantial amounts of zero trade observations has critical implications for log OLS regressions. The log of zero is undefined given than no number can be raised by any power to result in 0. As such, zero trade observations

would be omitted from an OLS regression that does not at the least transform the regressant of trade from ln (T), to ln $(T + 1)$.

While the measurement error of this correction from ln (T), to ln $(T + 1)$ is small, it generates inconsistent estimates because of the differences in the way zero and non-zero trade data materialises. Zero trade data may be the result of embargos or a lack of trade supporting infrastructure or resources. As such, simply adding 1 to a zero does not account for these fundamental differences between zero and non-zero trade data; the interpretation of these OLS coefficients would be biased and misleading (Kareem, Martinez-Zarazoso, Brümmer, 2016).

Secondly, an underlying assumption of OLS is that variables included in the model exhibit homoscedasticity (Silva and Tenreyro 2006). Silva and Tenreyro (2006) found evidence that the Anderson and Van Wincoop gravity model commonly used in studies on bilateral trade is highly heteroskedastic.

Specifically, they found:

"… strong evidence that the errors of the [Anderson and Van-Wincoop model] using the sample with positive trade are heteroskedastic. […] White's test for heteroskedasticity leads to a test statistic of 469.2 and a p-value of 0."

(Silva and Tenreyro 2006; page 12)

One of the sources of this heteroskedasticity is explained through a concept called "Jensen's inequality", where the expected value of the log of a random variable is not equal to the log of its expected value; i.e., $E(\ln T) \neq \ln E(T)$. Liu (2009) describes the

expected value of trade, T, depends on its mean and the higher order of moments, which are complex statistical measurements used to estimate shape parameters.

Liu (2009) makes the point that log linear gravity regressions only capture the first order approximation, which means that more complex relationships in the error terms are excluded from the estimation. This generates a skewed distribution of error terms, which gives rise to heteroskedasticity, and severely limits the power of interpreting the coefficients of log-linearised gravity models.

Silva, Tenreyro, and Liu hold the view that the Poisson model is superior to the standard log-linear models common in the literature. This is because Poisson regression makes no assumptions in regard to homoskedasticity, unlike OLS. As such, Poisson estimations would be more consistent when the data is heteroskedastic.

Silva and Tenreyro (2006) make comparisons to other models which would be suited to heteroskedastic trade data, namely the nonlinear least square (NLS) and gamma pseudo-maximum likelihood (GPML) estimators. Regardless, they conclude that the NLS and GPML models are too sensitive to rounding errors which created biases when compared to the robust results of the PPML estimator.

3.4: Poisson-Pseudo-Maximum-Likelihood-High-Dimensional-Fixed-Effects

The data will be regressed through the statistical software Stata 18.0. At Silva and Tenreyro's (2021) recommendation, this study will regress the data using the Poisson pseudo-maximum-likelihood-high-dimensional-fixed-effects (PPMLHDFE) command developed by Correia, Guimaraes, and Zylkin (2020).

This is because the standard Poisson command may have issues if the dependant variable has many zeros, and if the model uses many dummy variables. Both of these characteristics are present in this studies data and model.

However, this does mean this study will take a marginally different methodological approach than in Liu (2009), as he calculates both random and fixed effects Poisson models, and then uses a Hausman statistical test to determine which model is preferable. As the PPMLHDFE does not have a random effects counterpart, this study includes an additional estimation of the data using an xtpoisson random effects regression to compare the results to Liu's publication.

3.5: Data

This study extends the dataset used by Liu (2009) from the years of 1948-2003, to 1960-2020.

While the majority of the dummy variables used by Liu (2009) can be extended past 2003 (see Section 3.6), contemporary data was needed to fill the years between 2004 and 2020. Consequently, this study procured original data for its measure of imports, GDP, and GDP per capita.

Country pair import data was sourced from the IMF's Direction of Trade Statistics (DOTS) website (IMF 2023). GDP and GDP per capita data was sourced from the World Bank database (World Bank 2023).

For data sourced from the World Bank, reliable information only went back as far as 1960. This is the earliest year utilised in this study's model. This study has no interest in combining datasets together to obtain estimates for years before 1960. This is because

combinations could overlook variations in data collection practices among different data providers. Consequently, such a practice may reduce the statistical strength of estimations.

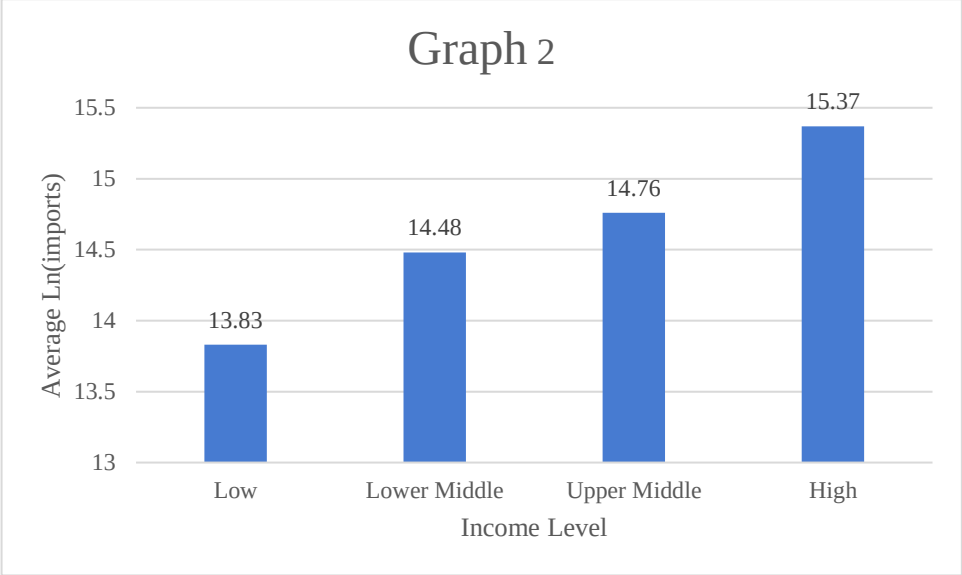
The variables included in this study's fixed, and random effect models are shown in the appendix under Table 2A and Table 2B, respectively.

Furthermore, summary statistics of these variable are presented in the appendix, under Table 3A and Table 3B for the fixed and random effect variables, respectively.

From the data presented in Table 3A, there is a high degree of variation across trade observations, as suggested by the standard deviation of $lnimports$ (7.69). Additionally, the maximum value of lnimports being much greater than the average signals positive (rightward) skewness in the distribution of this variable. This skewness could potentially lead to a violation of the homoscedasticity assumption in an OLS regression. However, as stated in Section 3.2, the Poisson model makes no assumptions about the distribution of errors.

Around 44% and 43% of the observations fall into the $bothin$ and $onein$ categories, respectively. Furthermore, the high average value for GDP and GDP per capita may indicate many of the observations are for large, high-income countries. Consequently, this may indicate large amounts of missing data for developing countries.

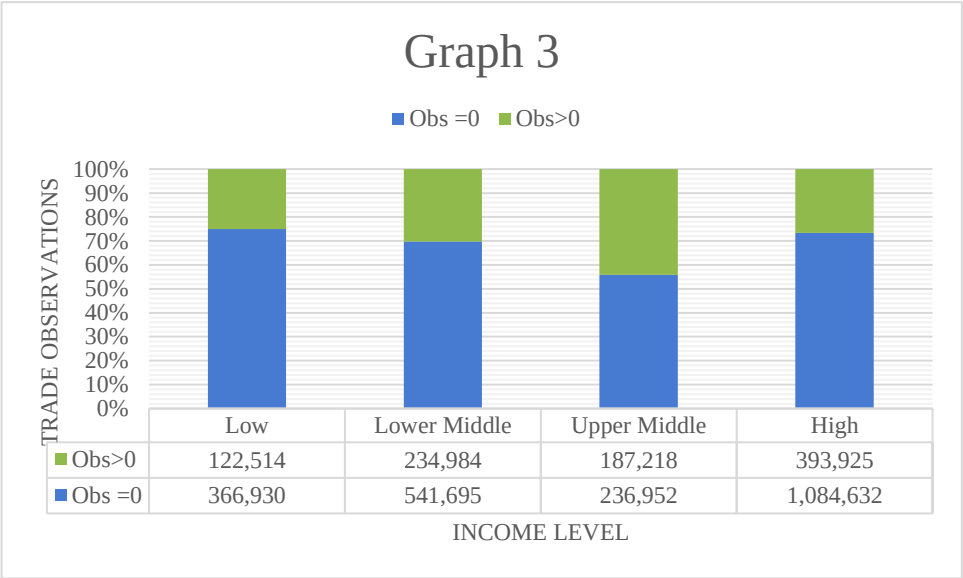
Graph 2 depicts the average value of $lnimports$ across different income levels, as defined by the WTO[2]:



Visually, there appears to be an upwards trend between income and imports. This makes sense and may suggest that as countries become wealthier, they engage in more trade simply because they can afford to. However, this data suggests that High-income countries only import 11% more than Low-income countries ($\frac{13.83-15.37}{13.83} * 100 = 11.12$), so this effect is not particularly strong.

[2] Defined in GDPPC: Low income =<1,135$; Lower Middle=<4,464$; Upper Middle=<13,844$; High=>13,845$ (World Bank, 2023).

Graph 3 describes the percentage of zero trade observations for $lnimports$:



Across income classes, approximately 60-70% of trade observations are equal to 0. This is greater than the observations regarding 0 trade data from Haveman and Hummels (2004) as well as Helpman, Melitz and Rubinstein (2008) discussed in Section 3.3. In turn, this may imply that the DOTS data is not an accurate representation of bilateral trade. While it would be expected that there would be lots, perhaps even half of observations that had missing values, this magnitude of missing data may harm the reliability of the conclusions drawn from the results.

3.6: Data extensions

18 additional countries joined the WTO after 2003. Liu's data has been amended to accurately reflect the membership status of these new accessioned countries. A list of the countries that joined after 2003 and their accession dates are listed in the appendix under Table 4.

3.7: Poisson Equation

Despite the PPMLHDFE model being this study's primary regression method, which is a fixed-effects model, a random Poisson model is also included to estimate the consistency of the PPMLHDFE.

The fixed effect equation used for the PPMLHDFE regression is displayed below:

$$\begin{aligned}\ln(imports) = {} & b_1 bothin + b_2 onein + b_3 lgdpA + b_4 lgdpB + b_5 lgdppcA \\ & + b_6 lgdppcB + b_7 Curcolony + b_8 Curcolonizer + b_9 Remote \\ & + b_{10} RTA + b_{11} GSPAB + b_{12} GSPBA + b_{13} CU + b_{14} Alliance + \mu_{ab} \\ & + \varepsilon\end{aligned} \tag{1}$$

The fixed effects model allows the control of time invariant differences across pairs of country A and B, thereby limiting potential biases from omitted variables. This is captured in the μ_{ab} term. The longer, random effects equation is displayed:

$$\begin{aligned}\ln(imports) = {} & b_1 bothin + b_2 onein + b_3 lgdpA + b_4 lgdpB + b_5 lgdppcA \\ & + b_6 lgdppcB + b_7 Border + b_8 Landlock + b_9 Island + b_{10} Samelang \\ & + b_{11} Samerelig + b_{12} Colony + b_{13} Colonizer + b_{14} Curcolony \\ & + b_{15} Curcolonizer + b_{16} Comcol + b_{17} Remote + b_{18} RTA \\ & + b_{19} GSPAB + b_{20} GSPBA + b_{21} CU + b_{22} Alliance + b_{23} Hostility \\ & + u + \varepsilon\end{aligned} \tag{2}$$

Unlike the fixed effects model, which controls for time invariant differences across country pairs, the random effects model assumes these differences are unrelated to the

independent variables. In turn, this allows for the inclusion of time invariant effects in the model. This is captured in the u term.

4.1: Results Introduction

This section quantitatively measures how GATT/WTO membership affects country pair trade data. PPMLHDFE regressions were run using original data gathered for this study and are compared to a plethora of regressions using Liu's data from his original study. Changes are made to the range of years included in regressions to measure temporal aspects of membership. The effect the Uruguay Round had on promoting trade among developing countries is also studied.

The core finding of this study suggests that between 1960 and 2020, GATT/WTO membership strongly and significantly promoted trade among country pairs, but this effect was reduced by nearly half if only one country in a pair has membership.

4.2: PPMLHDFE regression results

Table 5 presents the results of the Poisson regression for the whole dataset (from 1960 to 2020) using the PPMLHDFE command developed by Correia, Guimaraes, and Zylkin (2020).

The regression results indicate that, all other things being equal, a pair comprising two GATT/WTO members trade 62% more ($e^{0.48} - 1 = 0.6161$), compared to the baseline case of non-member pairs. By comparison, if one country in a pair is a GATT/WTO member, they trade 34% more ($e^{0.29} - 1 = 0.3364$) than the baseline case. Hereon,

these effects will also be referred to as the intensive and extensive marginal effects, respectively. Both of these results are statistically significant to a 99% confidence level.

This evidence is largely consistent with the findings of Liu, in addition to the broader literature that does not utilise Poisson regressions to estimate the trade effects of GATT/WTO membership. Specifically, the results summarised here indicate that membership has a stronger effect on promoting trade at the extensive margin compared to Liu's fixed effect Poisson model; Liu's findings indicate membership promoted trade by 60%, and 23% at the intensive and extensive margins respectively.

The positive and statistically significant results in Table 5 contrast with the "GATT pessimist" strand of literature; authors who found evidence that was either statistically insignificant or negative (Rose 2004, Gowa and Kim 2005, Cho and Zheng 2021).

Despite noting that membership had a marginally stronger effect compared to Liu's findings, the gap between the intensive and extensive marginal effects appears smaller compared to Liu's. In this study, the gap is 28 percentage points (62%-34%), whereas in Liu's study, this gap was 37 percentage points (60%-23%).

As in Silva and Tenreyro (2006), a Regression Equation Specification Error Test (RESET) is performed to detect misspecification. Unfortunately, Poisson regressions do not have many post-estimation tests built-in to Stata 18.0. As such, the RESET test is performed manually using a sample of code[3] from Silva and Tenreyro (2021).

The results are not encouraging as a $p = 0.000$ implies model misspecification. This could be due to omitted variables from the model, but this is unlikely as the core

[3] Code available: https://personal.lse.ac.uk/tenreyro/reset.do

variables are consistent between this studies and Silva and Tenreyro (2006), whose RESET test did not imply misspecification [4].

However, the Likelihood Ratio Test (LRT) also produces a $p = 0.000$, which implies that that the model offers statistically significant explanatory power.

Therefore, this study's model is statistically better than one with no predictors at all, but said model is misspecified in some way.

4.3: PPMLHDFE Liu data

Liu does not explicitly state what statistical software was used in his study, but given it was published in 2009 he is unlikely to have used the Poisson pseudo-maximum-likelihood-high-dimensional-fixed-effects command developed by Correia, Guimaraes, and Zylkin (2020) for STATA. As such, Liu's data from his original publication is estimated using the PPMLHDFE command to measure to what extent the stronger extensive margin effect found earlier is the result of this command.

Table 6 presents the results of regressing Liu's data through the PPMLHDFE estimation. These results are markedly stronger compared to his original publication.

These results imply a country pair of two members trade 55% more ($e^{0.44} - 1 = 0.5527$) than the baseline case, which is marginally weaker than his original estimation of 60%. Furthermore, the model suggests a country pair with one member trades 40% more ($e^{0.34} - 1 = 0.4049$) than a pair with no members, which is stronger than his original finding of an 23% increase. The model retains statistically significant

[4] Silva, J.M. and Tenreyro, S. (2006) 'The log of gravity', *The Review of Economics and Statistics*, 88(4), pp. 650.

explanatory power. As such, these results are consistent with the evidence produced in Table 5, with the exception that the extensive margin appears stronger by 6 percentage points $[(e^{0.29} - 1) - (e^{0.34} - 1) = 0.068]$.

It appears the PPMLHDFE model offers a more nuanced interpretation of the trade effects of GATT/WTO membership compared to the Poisson regression in Liu's publication. Even though a pair of members trade 5 percentage points less compared to Liu's original estimation, the model indicates that a pair with only one member trades at a magnitude that far exceeds the original estimation and thus may compensate the former disparity.

As before, a RESET test is conducted on the PPMLHDFE model using Liu's (2009) data to detect if the prior results are caused by omitted, or misspecified form. Again, the results imply model misspecification to the same degree. As the only difference between this section's results and Liu's are the Poisson command, it is possible that the PPMLHDFE command is resulting in these misspecifications. Like this study's original model, Liu's data produces an LRT that implies the model offers statistically significant explanatory power.

4.4: xtpoisson fe | re regression

Despite the PPMLHDFE command being strongly recommend by Silva and Tenreyro (2021), it is slightly limited in that it cannot be used to estimate random effects without implied misspecification. Further, there is the possibility that the command is causing a strong positive bias on the extensive margin effect, given that both regressions have produced evidence that is significantly greater than Liu's original estimation.

Additionally, Correia, Guimaraes, and Zylkin (2020) did not run a RESET test in their original publication, so perhaps this command is causing model misspecification.

The xtpoisson command is included in the Stata 18.0 base package and can investigate these issues and may grant results that could be more closely aligned with those of Liu (2009).

Table 7 presents the results of the xtpoisson regression on this study's original dataset. The results are very similar to the ones garnered from the PPMLHDFE regression. Notably, under (1) random effects, trade for country pairs where both are GATT/WTO members are predicted to trade more by 55% ($e^{0.44} - 1 = 0.5527$) compared to the baseline case. By comparison, trade for country pairs where only one country is a member is predicted to trade more by 31% ($e^{0.27} - 1 = 0.3099$), all other things being equal.

For the fixed effect results (2), a country pair for two GATT/WTO members are predicted to trade by 52% ($e^{0.42} - 1 = 0.5219$) more compared to the baseline case; a pair with only one member present is predicted to trade more by 30% ($e^{0.26} - 1 = 0.2969$), all other things being equal.

Liu uses a Hausman test to quantify if the random effect results are superior to the fixed effect ones. While he ultimately rejects the Hausman null hypothesis to favour the fixed effect results, this study's models were unable to generate a definitive result. With a negative chi2[5], it suggests there is a violation of the Hausman test assumptions.

Liu (2009) notes that the random effects Poisson model needs additional assumptions that are often at odds with those made by the Hausman test. However, he offers no recourse to circumvent this issue. Furthermore, both tests have a p-value of 0 for their

[5] $chi2(14) = -150488.53$

respective chi-square test, and only have marginally different log-likelihoods[6]. A greater log-likelihood value indicates that one model offers statistically more explanatory power compared to another. Due to these issues, this study cannot quantitively state if the random or fixed effect model is superior to the other.

Regardless, this study will continue under the assumption that the fixed effect Poisson model is preferred, wholly because the established literature believes it is generally very consistent and comparatively robust (Wooldridge 1999, Silva and Tenreyro 2006, Liu 2009).

The xtpoisson fixed effect model produces results which are similar to the core findings of this study as presented in Table 5. The intensive margin effect appears stronger in the PPMLHDFE model, suggesting a 62% increase in trade compared to the xtpoisson's 52%. However, the extensive margin effects are only marginally weaker compared to the PPMLHDFE, 34% against 30% respectively.

The results from Table 7 suggest that the strong extensive margin effect seen in Table 5 and 6 is not a quirk exclusive to the PPMLHDEFE model. In turn this may suggest that these commands offer stronger statistical power in observing the extensive margin effects of GATT/WTO membership compared to the Poisson regression Liu (2009) used. Additionally, the PPMLHDFE detects marginally stronger effects from membership at no loss of explanatory power when comparing log-likelihood values.

RESET tests are performed on models (1) and (2) of Table 7. Again, both results imply model misspecification. This gives evidence that it is not the PPMLHDFE command that is causing these results. The following two sub-sections do not introduce new

[6] $(2): -7050037 < (1): -6944405$

variables or estimation methods, and as such are unlikely to rectify the consistent misspecification seen in this study. Their results will be discussed in Section 4.9.

4.5: Temporal effects of membership

The reasons why this study's results marginally diverge from Liu's could be because the range of data studied in both models differs. As Liu's data ranged from 1948 to 2003, it includes observations of when then GATT was in its infancy and was largely ineffective at promoting trade through reciprocal liberalisation. As described by Irwin (1995), the GATT's momentum in tariff reduction stalled early in the postwar period, and its success in doing so only becomes more uniform in the latter half of the 1950s. Additionally, it's feasible that the inclusion of an additional 14 years of trade observations after 2003 can better detect the effects the 1995 Uruguay Round had on the promotion of trade.

To test this, two additional models are analysed. Firstly, the PPMLHDFE model presented in Table 5 is estimated again with a reduced date range of 1960 to 2003. Secondly, Liu's data is estimated using the same technique. The results of these regressions are presented in Table 8.

The regressions estimate very similar results. Model (1) produces coefficients of 0.33 and 0.19 depending on if both of only one country in a pair is a GATT/WTO member respectively. In turn, this predicts membership increases trade by 39% ($e^{0.33} - 1 = 0.3909$), and 21% ($e^{0.19} - 1 = 0.2092$) compared to the baseline case. By comparison model (2) which uses Liu's data, suggests membership increases trade by 40% ($e^{0.34} - 1 = 0.4049$) and 28% ($e^{0.25} - 1 = 0.2840$) respectively.

This is interesting, as the membership effects of Liu's data in model (2) Table 8 become significantly more muted as the first 12 years of observations are cut. This appears to contrast with Irwin's description of the inefficiencies of the GATT. By removing observations from the early years of the GATT when the institution was inefficient at promoting bilateral trade, we would expect the trade effects of membership to become stronger as observations that dilute the impact of trade are cut.

By comparison, the weakening effect of membership on trade as later observations are dropped in model (1) Table 8 makes more sense. This is because membership benefits incurred from the Uruguay Round in 1995 are very likely to have a lagged effect on trade and, when removing a significant portion of post Uruguay Round observations, this positive lagged effect is also muted. This is consistent with the findings of Tang and Wei (2009), Brotto et al (2021), and Cho and Zheng (2021), who stress that membership to the GATT/WTO resulted in lagged economic benefits, rather than an immediate positive effect.

Additionally, the PPMLHDFE regression results of the model (1) are indicated to be preferable to Liu's model. This is because model (1) produced a log-likelihood value greater than that of model (2)[7] of Table 8.

4.6: Impact before and after 1995

It is well documented that the accession process for developing countries changed with the Uruguay Round in 1995. As a reminder, prior to 1995 developing countries were not expected to engage in reciprocal liberalisation to the same extent as developed

[7] $-4779683.12 < -4044146.5$

members. In fact, during 1993 to 1994, 17 developing countries accessioned under Article XXVI, which did not stipulate any obligations to liberalise. This fact has been highlighted numerous times in the literature as symptomatic of producing a downward bias on estimations (Rose 2004, Subramian and Wei 2007, Tang and Wei 2009).

Further estimations are made to evaluate the theory that the post Uruguay Round time period contained significantly positive trade effects of membership. Table 9 contains the results of three PPMLHDFE regressions. The first contains data on developing countries that accessioned to the GATT/WTO in the first half of the 1990s. The second regression includes developing members that joined after 1995.

The country pair effects of two members are 2 percentage points greater after 1995 than before, $[(e^{0.12} - 1 = 0.1274) - (e^{0.10} - 1 = 0.1051) = 0.022]$. By comparison, the country pair effect of one country being a member are 6 percentage points greater $[(e^{0.10} - 1 = 0.1051) - (e^{0.04} - 1 = 0.0408) = 0.064]$.

This suggests that the post Uruguay Round effect on promoting developing members trade is positive, but not nearly as strong as the literature would suggest. Consequently, this may imply that even though developing countries were not required to liberalise to the same extent as developed members before 1995, those that accessioned during the first half of the 1990s engaged in significant liberalisation.

This can be tested further by isolating the countries that accessioned under Article XXVI. The third regression in Table 9 presents these findings which suggest a country pair of two members trade only 7% more than the baseline case. By comparison, one member in a pair trades 1% more than a pair of non-members, however, this latter metric is not statistically significantly different from 0.

These Article XXVI results are consistent with the findings of Tang and Wei (2009), who found the same group of countries garnered very weak, to no economic benefit from accessioning to the GATT/WTO.

4.9: Discussion

These results have confirmed that membership to the GATT/WTO has a large and significant effect of trade. This has important implications for non, and current members of the WTO.

For non-members, these results show how they have been put at a growing disadvantage overtime, given how accession has significantly increased trade between members relative to non-members. These boons to trade also have wider economic implications. Greater integration with the global market means being able to consume beyond one's domestic capabilities, which would imply a greater welfare benefit from membership. Additionally, one's economy becomes more attractive to Foreign Direct Investment when commitments are made to independent bodies, and trade becomes more predictable.

However, these positive trade increases are not guaranteed. Making commitments to independent bodies is critical to generating these positive trade effects. In turn, this could inform future negotiations and decision making beyond promoting trade, to other fields such as environmentalism.

For current members, these results reaffirm the value of the WTO, and the need to maintain their commitments during a period where global trade looks increasingly less stable. Furthermore, by highlighting the WTO's success in promoting trade and its

wider economic implications, it should dissuade demagogues from exploiting people's scepticisms in international institutions.

This study has confirmed what Silva and Tenreyro (2021), and Correia, Guimaraes, and Zylkin (2020) suggest regarding the PPMLHDFE's appropriateness for measuring the trade data, but fail to garner a metric suggesting appropriate model specification to a statistical degree. The results are consistent across datasets, and marginally stronger membership effects are detected compared to the xtpoisson command at not loss of explanatory power.

Regarding limitations, Kareem, Martinez-Zarazoso, Brümmer (2016) point that using the log of trade data, +1 may generate inconsistent estimates because of the different ways zero and non-zero trade data occurs. While the random model included a metric for hostility, this data came from Liu (2009) and was a static variable. As such, these results may be limited as an embargo dummy variable should have been included to limit inconsistencies.

Furthermore, there were a significant number of missing values for import data from the DOTS data package, as discussed in Section 3.5. A process where exports are used from country B to A as a proxy variable could have been conducted, but was not. Therefore, conclusions drawn from these results may be misleading.

While not explicitly reported, The RESET tests for models discussed in Sections 4.5 and 4.6 also resulted in a p-value of 0, reflecting the consistent issue of model misspecification across this study. The consistent issues regarding the RESET test pose a mystery in the Poisson discussion. Both Liu (2009) and Correia, Guimaraes, and Zylkin (2020) failed to include measures for model misspecification in their publications, so this studies ability to compare RESET metrics is limited to Silva and

Tenreyro (2006). A possible avenue that has yet to be discussed could be due to Stata having limited direct post estimation methods for Poisson regressions. This study's RESET tests have been conducted manually, using code provided by Silva and Tenreyro (2021), rather than using a direct Stata test. Further research is need to determine the source of this misspecification, as it severely limits the statistical power of otherwise rather promising results.

5.1: Conclusion

Whether or not the GATT/WTO has been successful in promoting trade has been a hotly debated topic for some time now. In 2004, Rose tried to answer how successful the institution had been in promoting trade, and his conclusion that membership was not statistically significant prompted intense evaluation of the effects of membership. More recently, we've witnessed strongman politicians and demagogues exploit people's scepticisms in globalisation to describe how the WTO has been a disaster for their domestic economies.

In 2009, Liu used a Poisson regression to measure how membership had affected country pair data between 1948 to 2003. This study extended this data range from 1960 to 2020, and found that membership to the GATT/WTO had a strongly positive, and statistically significant effect on countries trade to the tune of 62% and 34% depending on if a country pair had two or one members, respectively. Compared to Liu's (2009), these results were marginally stronger on the intensive margin, but significantly stronger on the extensive margin. Future research could determine why this is.

Further tests are conducted to determine if the stronger extensive margin effect was a quirk of the PPMLHDFE command developed by Correia, Guimaraes, and Zylkin

(2020), but this stronger effect was also detected in results garnered through the xtpoisson command available in Stata.

The trade effects of membership where stronger for developing countries that accessioned after the 1995 Uruguay Round compared to those that accessioned before it. However, this difference is weaker than the literature would suggest. When compared to specific countries that accessioned with no obligations to engage in reciprocal liberalisation, this difference becomes markedly stronger. This highlights the importance of developing countries committing to obligations in order for the benefits of membership to materialise.

Further research is needed to determine the root cause of the consistent RESET issues in this paper, as their presence limits the statistical reliability of the above results.

6.1: Appendix

Table 2A Fixed effect model variable description	
Variable	Description
$lnimports$	The dependant variable of the regressions in Section 4. Calculated as the log of imports of country A from country B, +1. The misspecification of adding 1 to imports is minute and is preferable to the alternative of creating many missing observations which would create a downward bias in estimations.
$Bothin$	A dummy variable, =1 if both country A and B are GATT/WTO members in time t, and 0 if otherwise.
$Onein$	A dummy variable, =1 if only one of either country A or B are GATT/WTO members in time t, and 0 if otherwise.
$lgdpA$	The log of GDP for country A in time t.
$lgdpB$	The log of GDP for country B in time t.
$lgdppcA$	The log of GDP per capita for country A in time t.
$lgdppcB$	The log of GDP per capita for country B in time t.
$Curcolony$	A dummy variable, =1 if country A is a current colony of country B.
$Curcolonizer$	A dummy variable, =1 if country A is a current colonizer of country B.
$Remote$	The distance of a country pair to the rest of the world, weighted by all other countries GDPs in time t.
Rta	A dummy variable, =1 if country A and country B are part of a regional trade agreement.
$Gspab$	A dummy variable, =1 if country A offers country B a Generalised System of Preferences in time t.
$Gspba$	A dummy variable, =1 if country B offers country A a Generalised System of Preferences in time t.
CU	A dummy variable, =1 if country A and country B are members of the same currency union.
$Alliance$	A dummy variable, =1 if country A and country B are members of the same military alliance.

Table 2B Random effect model variable description	
Variable	Description
$Ldist$	The log of distance between country A and B's borders.
$lareaA$	The log of country A's area.
$lareaB$	The log country B's area.
$Border$	A dummy variable, =1 if country A and B share a common border.
$Landlock$	A dummy variable, =1 if country A is landlocked.
$Island$	A dummy variable, =1 if country A is an island.
$Samelang$	A dummy variable, =1 if country A and B share a common language.
$Samerelig$	A dummy variable, =1 if country A and B share a common religion.
$Conoly$	A dummy variable, =1 if country A was ever a colony of country B.
$Colonizer$	A dummy variable, =1 if country A had ever colonized country B.
$Comcol$	A dummy variable, =1 if country A and country B where ever colonised by the same country.
$Hostility$	The military intensity conflict between country A and country B.

Table 3A Fixed effect model summary statistics					
Variable	Observations	Mean	Std. dev.	Min	Max
$lnimports$	2,127,224	6.15	7.69	0.00	27.01
$Bothin$	2,127,224	0.44	0.50	0.00	1.00
$Onein$	2,127,224	0.43	0.50	0.00	1.00
$lgdpA$	1,669,352	23.91	2.21	16.89	30.62
$lgdpB$	1,669,352	24.41	2.24	16.89	30.62
$lgdppcA$	1,668,784	8.27	1.47	4.97	11.77
$lgdppcB$	1,668,784	8.48	1.47	4.97	11.77
$Curcolony$	2,127,224	0.00	0.03	0.00	1.00
$Curcolonizer$	2,127,224	0.00	0.02	0.00	1.00
$Remote$	2,127,224	0.86	1.74	0.00	4.50
Rta	2,127,224	0.10	0.30	0.00	1.00
$Gspab$	2,127,224	0.09	0.28	0.00	1.00
$Gspba$	2,127,224	0.13	0.34	0.00	1.00
CU	2,127,224	0.02	0.14	0.00	1.00
$Alliance$	2,127,224	0.07	0.26	0.00	1.00

Table 3B
Random effect model summary statistics

Variable	Observations	Mean	Std. dev.	Min	Max
$Ldist$	2,127,224	8.68	0.80	4.15	9.91
$lareaA$	2,127,224	11.51	2.71	1.95	16.92
$lareaB$	2,127,224	11.70	2.61	1.95	16.92
$Border$	2,127,224	0.02	0.14	0.00	1.00
$Landlock$	2,127,224	0.31	0.51	0.00	2.00
$Island$	2,127,224	0.42	0.58	0.00	2.00
$Samelang$	2,127,224	0.12	0.32	0.00	1.00
$Samerelig$	2,127,224	0.51	0.50	0.00	1.00
$Colony$	2,127,224	0.01	0.09	0.00	1.00
$Colonizer$	2,127,224	0.00	0.07	0.00	1.00
$Comcol$	2,127,224	0.16	0.37	0.00	1.00
$Hostility$	2,127,224	0.01	0.09	0.00	3.33

Table 4: WTO accessioned since 2004			
Nepal	2004	Russia	2012
Cambodia	2004	Vanuatu	2012
Saudi Arabia	2005	Laos	2013
Vietnam	2007	Tajikistan	2013
Tonga	2007	Yemen	2014
Ukraine	2008	Seychelles	2015
Cabo Verde	2008	Kazakhstan	2015
Montenegro	2012	Liberia	2016
Samo	2012	Afghanistan	2016

(Source: WTO, 2023)

Table 5: PPMLHDFE – Whole dataset 1960-2020		
Variable	Coeff.	S.E.
$bothin$	0.48**	0.01
$onein$	0.29**	0.01
$lgdpA$	0.17**	0.00
$lgdpB$	0.15**	0.00
$lgdppcA$	0.07**	0.00
$lgdppcB$	0.02**	0.00
$curcolony$	-0.09	0.05
$curcolonizer$	0.35**	0.03
$remote$	0.05**	0.00
rta	0.15**	0.00
$gspab$	0.27**	0.00
$gspba$	0.10**	0.00
cu	0.24**	0.01
$alliance$	0.13**	0.00
No. Obs	1,367,222	
Log pseudolikelihood	-7050036.07	
LRT p-value	0.0000	
RESET p-value	0.0000	

Table 6: PPMLHDFE – Liu data 1948-2003		
Variable	Coeff.	S.E.
$bothin$	0.44**	0.00
$onein$	0.34**	0.00
$lgdpA$	0.13**	0.00
$lgdpB$	0.20**	0.00
$lgdppcA$	0.12**	0.00
$lgdppcB$	0.12**	0.00
$curcolony$	0.24**	0.02
$curcolonizer$	0.44**	0.02
$remote$	0.06**	0.00
rta	0.10**	0.00
$gspab$	0.32**	0.00
$gspba$	0.26**	0.00
cu	0.49**	0.01
$alliance$	0.24**	0.00
No. Obs	1,184,525	
Log pseudolikelihood	-5522766.28	
LRT p-value	0.0000	
RESET p-value	0.0000	

Table 7: Xtpoisson re| fe – Whole dataset 1960-2020				
	(1) Random effects		(2) Fixed effects	
Variable	Coeff.	S.E.	Coeff.	S.E.
bothin	0.44**	0.00	0.42**	0.00
onein	0.27**	0.00	0.26**	0.00
lgdpA	0.19**	0.00	0.16**	0.00
lgdpB	0.16**	0.00	0.15**	0.00
lgdppcA	0.03**	0.00	0.07**	0.00
lgdppcB	0.00**	0.00	0.01**	0.00
ldist	-0.20**	0.00		
lareaA	-0.02**	0.00		
lareaB	0.00	0.00		
border	0.05**	0.00		
landlock	-0.07**	0.00		
island	0.05**	0.00		
samelang	0.04**	0.00		
samerelig	0.01**	0.00		
colony	0.01*	0.00		
colonizer	0.08**	0.00		
curcolony	-0.04**	0.01	0.02	0.01
curcolonizer	0.36**	0.01	0.45**	0.01
comcol	0.03**	0.00		
remote	0.00**	0.00	0.05**	0.00
rta	0.05**	0.00	0.12**	0.00
gspab	0.25**	0.00	0.26**	0.00
gspba	0.08**	0.00	0.09**	0.00
cu	0.14**	0.00	0.25**	0.00
alliance	0.03**	0.00	0.15**	0.00
hostility	-0.18**	0.00		
No. Obs	1,367,222		1,367,222	
Log pseudolikelihood	-6,944,405.1		-7,020,353.9	
Alpha	-4.42	0.18		
RESET p-value	0.0000		0.0000	

Table 8: PPMLHDFE –1960-2003				
	(1) Original data		(2) Liu data	
Variable	Coeff.	S.E.	Coeff.	S.E.
$bothin$	0.33**	0.01	0.34**	0.00
$onein$	0.19**	0.01	0.25**	0.00
$lgdpA$	0.19**	0.00	0.12**	0.00
$lgdpB$	0.18**	0.00	0.19**	0.00
$lgdppcA$	0.07**	0.00	0.12**	0.00
$lgdppcB$	0.00	0.00	0.11**	0.00
$curcolony$	-0.10**	0.06	0.31**	0.02
$curcolonizer$	0.42**	0.03	0.53**	0.02
$remote$	0.06**	0.00	0.06**	0.00
rta	0.21**	0.00	0.13**	0.00
$gspab$	0.38**	0.00	0.35**	0.00
$gspba$	0.21**	0.00	0.29**	0.00
cu	0.36**	0.01	0.49**	0.01
$alliance$	0.15**	0.00	0.23**	0.00
No. Obs	811,749		1,017,223	
Log pseudolikelihood	-4044146.5		-4779683.12	

Table 9: PPMLHDFE – pre and post 1995						
	(1) Pre 1995		(2) Post 1995		(3) Article XXVI	
Variable	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
$bothin$	0.10**	0.02	0.12**	0.03	0.07**	0.01
$onein$	0.04**	0.02	0.10**	0.03	0.01	0.02
$lgdpA$	0.07**	0.00	0.06**	0.00	0.07**	0.00
$lgdpB$	0.07**	0.00	0.07**	0.00	0.06**	0.00
$lgdppcA$	0.01	0.00	0.00	0.00	0.01**	0.00
$lgdppcB$	0.01**	0.00	0.01**	0.00	0.01**	0.00
$curcolony$	0.00	(omitted)	0.00	(omitted)	0.00	(omitted)
$curcolonizer$	0.00	(omitted)	0.00	(omitted)	0.00	(omitted)
$remote$	0.03**	0.00	0.03**	0.00	0.02**	0.00
rta	0.09**	0.00	0.07**	0.00	0.11**	0.00
$gspab$	0.00	(omitted)	-0.02**	0.00	0.00**	(omitted)
$gspba$	0.03**	0.00	0.01**	0.00	0.02**	0.00
cu	0.17**	0.00	0.04**	0.01	0.15**	0.01
$alliance$	0.09**	0.00	0.08**	0.00	0.10**	0.00
No. Obs	58,785		55,191		35,200	
Log pseudolikelihood	-141645.43		-134936.10		-84382.50	

7.1: References

Anderson, J.E. (2011) 'The Gravity Model', *Annual Review of Economics*, 3(1), pp. 133–160.

Anderson, J.E. and van Wincoop, E. (2003) 'Gravity with gravitas: A solution to the border puzzle', *American Economic Review*, 93(1), pp. 170–192.

Bagwell, K. and Staiger, R.W. (1999) 'An economic theory of GATT, *American Economic Review*, 89(1), pp. 215–248.

Brotto, A., Jakubik, A. and Piermartini, R. (2021) 'WTO accession and growth: Tang and Wei Redux', *WTO Working Paper*.

Cho, M. and Zheng, X. (2021) 'Bayesian estimation of Dynamic Panel Data Gravity Model', *Econometric Reviews*, 40(7), pp. 607–634.

Correia, S., Guimaraes, P. and Zylkin, T. (2020), 'Fast Poisson estimation with high-dimensional fixed effects', *Stata Journal*, 20(1), pp. 95-115.

Dyer, G. (2016) 'Donald Trump threatens to pull US out of WTO', *Financial Times*, 24 July.

Eichengreen, B. and Irwin, D.A. (2010), 'The Slide to Protectionism in the Great Depression: Who Succumbed and Why?', *The Journal of Economic History*, 70(4), pp. 871-897.

Gowa, J. and Kim, S.Y. (2005) 'An exclusive country club: The effects of the GATT on trade, 1950–94', *World Politics*, 57(4), pp. 453–478.

Haveman, J. and Hummels, D. (2004), 'Alternative hypotheses and the volume of trade: the gravity equation and the extent of specialisation', *Canadian Journal of Economics*, 37(1), pp. 199-218.

Helpman, E., Melitz, M. and Rubinstein, Y. (2008), 'Estimating Trade Flows: Trading Partners and Trading Volumes', *Quarterly Journal of Economics*, 123(2), pp. 441-487

IMF. (2023) *Direction of Trade Statistics (DOTS).* Available at: https://data.imf.org/?sk=9d6028d4-f14a-464c-a2f2-59b2cd424b85 (Accessed: 04 September 2023).

Irwin, D.A. (1995) 'The GATT in Historical Perspective', *The American Economic Review*, 85(2), pp. 323-328.

Jawara, F. and Kwa, A. (2004) *Behind the scenes and the WTO: The Real World of International Trade Negotiations: Lessons of Cancun*. London: Zed Books Ltd.

Jawara, F. and Kwa, A. (2004) *Behind the scenes and the WTO: The Real World of International Trade Negotiations: Lessons of Cancun*. London: Zed Books Ltd.

Liu, X. (2009) ‘GATT/WTO Promote Trade Strongly: Sample Selection and Model Specification’, *Review of International Economics*, 17(3), pp. 428-446.

Rachman, G. (2022) *The Age of The Strongman: How the Cult of the Leader Threatens Democracy around the World*. London: Bodley Head.

Ravenstein, E.G. (1889) ‘The laws of migration’, *Journal of the Royal Statistical Society*, 52(2), p. 241.

Rose, A.K. (2004) ‘Do We Really Know That the WTO Increases Trade?’, *The American Economic Review*, 94(1), pp. 98-114.

Silva, J.M. and Tenreyro, S. (2006) ‘The log of gravity’, *The Review of Economics and Statistics*, 88(4), pp. 641–658.

Silva, J.M. and Tenreyro, S. (2021) *The ‘Log of gravity’ page*. Available at: https://personal.lse.ac.uk/tenreyro/lgw.html (Accessed: 04 September 2023).

Subramanian, A. and Wei, S.-J. (2007) ‘The WTO promotes trade, strongly but unevenly’, *Journal of International Economics*, 72(1), pp. 151–175.

Tang, M-K. and Wei, S-J. (2009) ‘The value of making commitments externally: Evidence from WTO accessions’, *Journal of International Economics*, 78(2), pp. 216-229.

Tinbergen, J. (1963) ‘Shaping the world economy’, *The International Executive*, 5(1), pp. 27–30.

Tomz, M., Goldstein, J.L. and Rivers, D. (2007) ‘Do we really know that the WTO increases trade? comment’, *American Economic Review*, 97(5), pp. 2005–2018.

World Bank Group country classifications by income level for FY24 (July 1, 2023- June 30, 2024). (2023) *World Bank Blogs*. Available at: https://blogs.worldbank.org/opendata/new-world-bank-group-country-classifications-income-level-fy24 (Accessed: 31 August 2023).

World Bank. (2023) *World Bank Open Data*. Available at: https://data.worldbank.org/ (Accessed: 04 September 2023).

WTO. (2023) *WTO*. Available at: https://www.wto.org/english/thewto_e/acc_e/acc_status_e.htm (Accessed: 31 August 2023).