International Fisheries Access Agreements and Trade

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Abstract

International fisheries access agreements allow fishermen from one country to harvest fish in another country's waters. They may involve direct financial compensation from the fishing country to the host or there may be indirect compensation such as building fisheries science or industry infrastructure or the agreements may allow bilateral access. In this paper we empirically consider the question of which countries make access agreements with each other and compare this to flows in fish trade. We combine datasets on access agreements and fish stock status with a dataset usually used to examine flows of international trade and data on fish product trade to form a unique panel. This allows us to test the competing hypotheses of whether access agreements are made or trade occurs because of the relative difference between stock status in harvesting versus host country waters or due to countries being close – either geographically, historically or culturally. Results suggest that relatively better stock status in the host country is an important determinant of both access agreements and fish trade but that closeness characteristics operate in different ways on these complementary paths of getting fish from one country's waters to consumers in another.

Keywords: International fisheries, access agreements, international trade, gravity, empirical

JEL classification: Q22, Q27, F13, F14, F18

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1 Introduction

Fishermen fishing outside their nation's territorial waters has occurred throughout history, in fact, the relative abundance of cod off the North East coast of North American was an important element in the early European settlement of those shores (Kurlansky 1998) as were the whale stocks in the southern oceans for Australia and New Zealand (Prickett 2002). However, the United Nations Convention on the Law of the Sea (UN 1982), which extended jurisdiction from a usual three to a 200 nautical mile exclusive economic zone (EEZ) around a nation, restricted the ability to engage in distant water fishing. Subsequently, for fishermen to legally harvest in another nations' waters, some form of access agreement needs to be in effect. These agreements are typically made at the national level although groups of nations such as the European Union or the Forum Fisheries Agency act as a single entity in negotiations. The popular image of these distant water fishing fleets is that as their domestic waters have been overexploited they have turned their eyes to the remaining areas of relative abundance off the coast of Africa or in the South Pacific, see for example commentary by Greenpeace (2012) or in the movie The Cove (2009). Academic work has stressed the importance of international sharing (McWhinnie 2009) and overcapitalization in fisheries in determining stocks status (Bonfil et al. 1998), whether or not distant water fleets are involved in harvesting.

In this paper we empirically examine which countries make these access agreements and why. In particular, we examine how important the relative stock status between the home country of fishermen and the host country's waters is in relation to other factors that impact on international agreements more generally. To do this, we generate a unique dataset by combining data from the Sea Around Us Project (2005) on fisheries access agreements and fish stock status with data from Head et al. (2010) on country-pair characteristics that influence international trade flows. Our core dataset includes 9046 country-pair-year access agreements in the period 1962-2000. This allows us to analyze whether agreements are made due to differences in fish stock status or because countries are close (geographically, historically or culturally). We further combine this with data on fish trade flows from Feenstra et al. (2004) to consider these alternative pathways to supply fish from one country's waters to consumers in another country.

To give a framework for our empirical analysis, we develop a model similar to Feenstra et al. (2001) that augments a model of homogeneous goods trade between two countries with imperfect competition to also allow for differences in relative fish stock status. This gives us straightforward predictions about the effect of relative stock status, economic mass and distance on the probability of an access agreement that we can take to the data.

The results indicate that relatively better stock status in the host country (as measured by mean trophic index or mean maximum fish length) is an important determinant of access agreements. Results on the measures of closeness have interesting and differing impacts, for example, sharing a maritime border or being in the same free trade agreement has no effect on the probability of an agreement but having a common currency reduces the probability. Fish product trade flows are also positively associated with relative higher stock status in the host (origin) country but trade is negatively correlated with sharing a maritime border and free trade agreements while having a shared colonial background and sharing a currency increases trade. Both the probability of an agreement and the incidence of trade increases for host countries that are economically larger on aggregate but poorer per capita and for fishing countries that are economically smaller but richer. These results suggest that access agreements and trade are operating as complementary supply paths but that closeness characteristics operate in different ways on these paths.

Past literature on fisheries access agreements includes case studies such as Bonfil et al. (1998). These studies allow important insight into the effects of particular agreements on fish stock status and the benefits and costs to the home and host countries. Case studies though, by their very nature, are unable to systematically distinguish whether the determinants of international relations more generally or fisheries specific comparative advantage are important for fisheries access agreements. Understanding the importance of these characteristics for the complementary pathways of agreements and trade will facilitate international efforts to improve the outcomes of fisheries access agreements, biologically and economically.

2 Conceptual Framework

Access agreements that allow fishermen from another country to harvest in the host countries waters are essentially replacing trade in final goods (fish) with trade in input services (fish harvesting). As such, we analyze the existence of agreements by considering the following two key hypotheses. First, that fisheries agreements are made due to the host country having a better stock of fish than the fishing country, that is, comparative advantage in the natural resource. Second, that fisheries agreements are made due to the geographic, historic or cultural closeness of countries, that is, the gravity effects studied in international trade.

The gravity equation of international trade predicts that the volume of trade between two countries is proportionate to their economic sizes and inversely related to trade barriers between them. The gravity equation is a great success in empirical studies in international trade, it has been used to estimate the effect on trade volumes of international borders,[1] currency unions,[2] and the WTO membership.[3]

Most of the studies estimate the gravity equation for volumes of trade, that is they study countries that have positive trade flows and disregard countries that do not trade with each other. Two papers that do consider the extensive margin,

[1] Anderson and van Wincoop (2003) introduce multilateral resistance term into the gravity equation and provide solution to the "border puzzle".

[2] Glick and Rose (2002) show that common currency doubles the volume of bilateral trade.

[3] One of the first empirical papers on this question, Rose (2004), finds no evidence that the WTO has increased world trade. Subramanian and Wei (2007) find that the WTO has had a strong positive impact on trade, amounting to about 120% of additional world trade.

that is the incidence of trade rather than the volume of trade, are Helpman et al. (2008) and Baldwin and Harrigan (2011). Helpman et al. (2008) develop a two-stage estimation procedure where the first stage estimates selection into trade partners and the second stage uses trade volumes. They argue that traditional estimates, which do not take into account selection into trade partners, suffer from the bias, which is mostly due to the omission of the extensive margin. Baldwin and Harrigan (2011) adopt the gravity equation to estimate the incidence of trade for US. They argue that theoretical models are unable to explain some of the empirical findings and propose a new quality-adjusted variant of the heterogenous firms model.

Even though the gravity equation is the most empirically successful model in international economics, its theoretical foundations are not as well understood. Most of the theoretical literature which derives gravity equation, focuses on either trade in differentiated products[4] or trade in homogenous goods with heterogeneity of technology across countries[5]. These models best describe trade in manufactures among industrial countries. However, the gravity equation works well empirically for both OECD and developing countries.[6] Feenstra et al. (2001) develop a model imperfect competition with homogenous goods in segmented markets to derive a gravity equation which is applicable to trade in non-differentiated goods with developing countries. Our theoretical framework is similar to theirs.

Consider two countries, South (S) and North (N). We assume that country S is poorer, that is $I_S < I_{N.}$, where I_S (I_N) is country S's (country N's) national income.

Firms in each country produce an identical homogenous product "fish". There is freedom of entry and exit, therefore the aggregate profits of each firm equals zero.[7] Each firm needs to pay a fixed cost of fishing, denoted by F_S (F_N) as well as per unit cost of fishing, c_S (c_N). The government in each country might choose to subsidize the fixed cost. We assume that the per unit cost of fishing depends on the fish stock

[4]See for example, Helpman et al. (2008) and Chaney (2008).

[5]See Eaton and Kortum (2002).

[6]See Hummels and Levinsohn (1995).

[7]This condition will determine the equilibrium number of firms in each country.

status in each country's waters and that the fish stock status is more beneficial to fishing in S. Hence we have that $c_S < c_N$.[8] Each firm is able to fish in either its domestic waters or fish in the other country's waters. For simplicity, we assume that access to foreign waters is free.[9] Firms can process fish only in their domestic countries, that is if they fish in foreign waters, they need to transport fish back home for processing. There is a per unit trade cost t, which is paid if either unprocessed fish is transported back home for processing or if the final product is harvested then exported to the other country. In addition, there is a fixed cost of exporting a final product. Finally, we assume that the markets are segmented and consumers in each country spend a fixed share of their income on fish.

It is straightforward to show that in equilibrium, access agreements allowing Northern firms to fish in Southern waters exist only if trade costs are low and if the difference in fish status is large, i.e., $t < c_N - c_S$. If $t > c_N - c_S$ then all firms fish in their own waters. It is also straightforward to show that larger domestic and export market size increase operating profits while larger fixed cost of fishing or exporting decreases total profits. We summarize these results in the following Proposition.

Proposition. *The probability that an international fisheries access agreement exists between South and North is increasing in difference in fish stock status and each country's GDP and decreasing in trade cost.*

3 Data

We create our dataset by combining data on: international fisheries access agreements; fish stock status; country-pair characteristics (à la standard gravity analysis); and fish trade flows. Each of these components is described below.

[8] Note that our framework is a simple static set-up where the fish stock status does not depend on the catch. Clearly, fish stock status is endogenous in a richer dynamic model of trade in renewable resources.

[9] The model can be easily modified by adding a negotiation stage to determine the access fee.

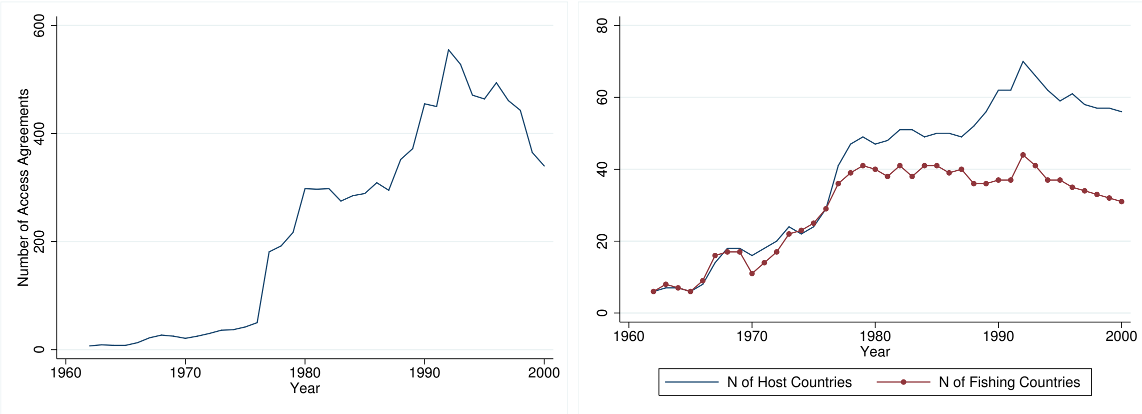
3.1 Fisheries Access Agreements

First, we use data on access agreements and fish stock status from the Sea Around Us Project (2005). The dataset on agreements includes countries included in the agreement, agreement type and years in force. Access agreements establish the rules for one nation to fish in another nation's waters. These agreements are typically bilateral, with two exceptions - agreements that have the European Union acting as a single entity and the agreement between the United States and the Pacific Islands Forum Fisheries Agency. Access agreements come in a variety of forms; some set exact limits on specific species, others allow access to vessels that traditionally harvested in areas prior to the extension of exclusive economic zones, and others grant blanket access rights. In return for access rights, the harvesting countries may reciprocate with access to their own waters, provide fisheries science and development funds, build ports or undertake fisheries joint ventures, or simply pay cash. While the contracts are binding they generally have a short (one- to five-year) timeframe and the host country retains the right to manage the fishery optimally, if they so desire.

Details regarding the exact degree of access and compensation are often not available, therefore in our empirical analysis we use a simple binary measure of whether there exists a fisheries access agreement between a pair of countries in a given year:

$$A_{ijt} = \begin{cases} 1, & \text{if there is an agreement between countries } i \text{ and } j \text{ in year } t \\ 0, & \text{otherwise} \end{cases}$$

Figure 1a depicts the number of access agreements over time globally. The number of agreements was fairly low until the mid-1970s. After this time, the number of agreements starts to increase dramatically, with the peak in early 1990s, and after that the number of agreements drops. The likely reason for the increase in



(a) Number of Access Agreements (b) Number of Countries in Agreements

Figure 1: Access Agreements 1960-2000

agreements is in anticipation of the UN Convention on the Law of the Sea (1982), which increased national property rights out to 200 nautical miles from shore. Figure 1b depicts the number of fishing and host countries over time which is a proxy for the extensive margin of the change in the global number of agreements. There is an increase in the number of both fishing and host countries starting from the late 1960s until early 1990s, after that the number of participating countries is decreasing.

Major Access Agreements

To provide some further context, we briefly describe some major access agreements from three key players: the European Union; the United States; and Japan.

The EU has a network of agreements in the Atlantic Ocean, the Indian Ocean and more recently in the Pacific. These agreements mostly target tuna and tuna-like species. There are approximately 600 EU fishing vessels operating under access agreements. In 2007, the value of the total catch under access agreements was €2 billion, which is approximately 20% of all EU fish catch. Most of the EU agreements include a financial compensation to the host country, where the payment is based on the number and type of vessels for a specified period of time. The financial compensation varies greatly between the different countries and species and amounts to only about 2 to 13 percent of the market value of the catch. In 2007, the total

EU payments were approximately €146 million.

The US has a major multilateral agreement through Forum Fisheries Agency (FFA) with 17 Pacific Island countries. This agreement targets only tuna and includes a fixed amount of financial compensation. In 2003, the access compensation was US$21 million which was approximately 22% of the catch value and covered 16 US purse seine vessels. In addition, the US also has bilateral agreements with Canada (starting from 1970s) and Mexico, Colombia and Brazil in the 1970-1980s.

Japan has access agreements in the Atlantic, Indian and Pacific Oceans that target mostly high-value tuna. The Japanese fleet usually fishes under private access agreements negotiated between the private sector associations and the host governments. Japanese agreements are not open to the public, therefore there is no information on catch limits and number of vessels.

3.2 Fish Stock Status

The measures of fish stock status also come from the Sea Around Us Project (2005). The mean trophic level was originally developed by Pauly et al. (1998) and is one of eight measures chosen by the Conference of the Parties to the Convention on Biological Diversity (CBD 2004) as an indicator of biodiversity loss. It takes annual fisheries catches since 1950 by species or species group and calculates:

$$MTL_t = \frac{\sum_s TL_s Y_{st}}{\sum_s Y_{st}}$$

where TL_s is the trophic level of species (or species group) s and Y_{st} is the landings of s in time t.[10] Pauly et al. (1998) showed a smoothly declining trend for MTL in most FAO areas that, based on the assumption that the relative abundance of species in the landing data was correlated with the relative abundance of the same

[10]The trophic level indicates where a species is in the food chain. A value of 1 is given to plants and detritus, a value of 2 to herbivorous fish who consume value 1 species, a value of 3 to fish that eat herbivorous fish, and so on; fish typically have a trophic level of 2-5, although 5 is rare.

species in the ecosystem, are interpreted as representing a decline in the abundance of high-trophic-level fishes relative to low-trophic-level fishes. The effects are that we are "fishing down the marine food web" and reducing biodiversity and is one measure of ocean area health.

Our second measure is the mean maximum length, which is a size-based measure of stock status that quantifies the relative abundance of small and large species:

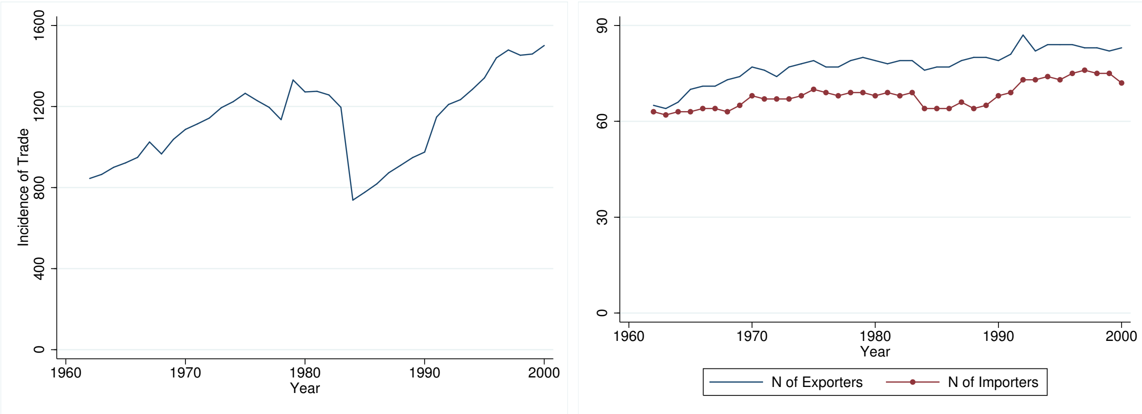
$$MML_t = \frac{1}{N_t} \sum_s N_{st} L_{st}^{max}$$

where N_t is the population in time t, N_{st} is the population abundance of species s in time t, and L_{st}^{max} is the maximum recorded length of species s in time t.[11] Declining mean maximum length also is a measure of stock status as older and genetically superior fish tend to be longer and it indicates "fishing down the food web" as higher trophic level fish are typically longer. We use the mean trophic level and the mean maximum length calculated at the country level such that MTL_{it} and MML_{it} are our measures each a country i's aggregate fish stock status in time t.

3.3 Country-pair Characteristics and Fish Trade Flows

We use data on country-pair characteristics from the CEPII Gravity Data (Head et al. 2010). The dataset covers pairs of countries globally, for the period 1948 to 2006 and includes the standard gravity variables used in the trade literature. The relevant variables for us include: distance between i and j; real GDP; population; and dummy variables for having the same language, sharing a major religion, ever being colonized by the other or by the same third country, having the same currency, being members of the same free trade area. We augment this standard gravity data by replacing whether the pair shares a land border to whether the pair shares a maritime border; and by replacing the land area measures with the size of each

[11] Shin et al. (2005) evaluates a variety of size-based measures for their ability to indicate stock status.



(a) Trade Incidence Over Time (b) Number of Exporting and Importing Countries

Figure 2: Fish Trade 1960-2000

country's maritime exclusive economic zone.[12,13]

Finally, we also use data on trade flows in fish products from the NBER-United Nations Trade Data (Feenstra et al. 2004). This dataset contains bilateral trade data by commodity for 1962-2000 and the data are organized by the 4-digit Standard International Trade Classification. We aggregate the data on value of bilateral trade for all fish-related products with 4-digit SITC=03** and we also create a dummy variable which indicates where there is bilateral trade in fish-related products between the pair of two countries. Analygously to Figures 1a and 1b, Figures 2a and 2b depict the incidence of trade pairs globally and the number of exporting and importing countries over time, respectively.

[12]We thank Kofi Otumawu-Apreku for providing valuable research assistance on this point using information from the Sea Around Us Project (2005) and VLIZ (2014).

[13]We drop all "countries" that are still colonies as they typically do not have consistently reported measures of access agreements. This means that we are likely to be underestimating the number of access agreements. For some colony-colonist relationships this will be unfair as the colony may be extremely autonomous with respect to fisheries management and should therefore be considered as separate. However, we had to draw the line somewhere as some states or islands that are part of the same country are quite autonomous with respect to fisheries management also.

Table 1: Summary Statistics: Means and Standards Deviations

	Agreement	No Agreement	Total
MTL Host Country	3.411	3.383	3.384
	(0.316)	(0.319)	(0.319)
MTL Fishing Country	3.346	3.354	3.354
	(0.195)	(0.290)	(0.287)
MML Host Country	69.68	69.53	69.53
	(31.55)	(27.53)	(27.69)
MML Fishing Country	58.90	66.14	65.88
	(18.31)	(25.73)	(25.53)
Trade Incidence	0.492	0.163	0.175
	(0.500)	(0.369)	(0.380)
Log GDP/cap Host	8.025	7.157	7.189
	(1.681)	(1.524)	(1.539)
Log GDP/cap Fishing	9.218	7.272	7.344
	(1.057)	(1.459)	(1.492)
Log Popn Host	1.830	1.743	1.747
	(2.050)	(2.252)	(2.245)
Log Popn Fishing	2.660	2.048	2.071
	(1.642)	(2.118)	(2.105)
Log Weighted Distance	8.062	8.844	8.815
	(0.880)	(0.732)	(0.753)
Maritime Border	0.135	0.0294	0.0333
	(0.342)	(0.169)	(0.180)
Log EEZ Host	5.786	5.987	5.979
	(1.693)	(1.508)	(1.516)
Log EEZ Fishing	5.676	5.752	5.749
	(1.645)	(1.670)	(1.669)
Same FTA	0.303	0.0250	0.0353
	(0.460)	(0.156)	(0.184)
Past Colony	0.0691	0.0213	0.0231
	(0.254)	(0.145)	(0.150)
Common Colonist	0.00862	0.0688	0.0666
	(0.0925)	(0.253)	(0.249)
Currency Union	0.00973	0.00932	0.00933
	(0.0982)	(0.0961)	(0.0962)
Common Legal	0.359	0.331	0.332
	(0.480)	(0.471)	(0.471)
Common Language	0.122	0.169	0.167
	(0.327)	(0.375)	(0.373)
Religion	0.214	0.163	0.165
	(0.275)	(0.233)	(0.235)

Notes: There are 9,046 country-pair-years with agreements and 235,754 without for a total of 244,800 observations.

3.4 Data Summary Statistics

Our complete dataset includes countries which have at least one international access agreement over the time period 1962-2000.[14] Combining data from such a variety of sources has left us with 244,800 country-pair-year observations. The number of observations that have $A_{ijt} = 1$ is 9,046, which is 3.7% of all observations.

Table 1 shows the summary statistics by whether or not a country-pair-year combination has an access agreement. Casual observation shows that the first measure of fish stock status in host and fishing countries, Mean Trophic Level, does not exhibit great differences whether there is an agreement or not for either Host or Fishing Country. The second, Mean Maximum Length, does appear to be smaller in the fishing country if there is an agreement. The value of fish trade is higher amongst countries that also have agreements. The gravity variables indicate that on average, countries that have access agreements: have a shorter distance between them; are more likely to share a maritime border; have higher GDP per capita; are more likely to be a part of the same free trade area; and are less likely to have the same language or religion or have shared a colonist.

4 Empirical Analysis

Our goal in this section to test our Proposition from Section 2, that is, to evaluate the relative resource abundance motive and the 'gravity' motives for making an access agreement. The empirical strategy is to augment the extensive margin version of gravity model with measures of fish stock status. As the data is a panel, we can identify the effect of fish stock status on access agreements by comparing across country-pairs and through time.

[14] The full universe of possible pair-year combinations is greater than this but we exclude countries that never have agreements with anyone. This is because Lesotho not having an agreement with Austria is different than New Zealand not being a host to Costa Rica. This universe definition issue also arises in the trade literature where Australia not importing apples from Iceland is very different from Australia not importing apples from New Zealand.

Table 2: Simple Correlations: Stock Status Only

	Agreement	Agreement	Trade Incidence	Trade Incidence
MTL Host/MTL Fish	0.177***		-0.257***	
	(0.032)		(0.021)	
MML Host/MML Fish		0.062***		-0.115***
		(0.006)		(0.004)
Constant	-1.968***	-1.864***	-0.675***	-0.798***
	(0.033)	(0.009)	(0.022)	(0.006)
Observations	244800	244800	244800	244800

Notes: Dependent Variables: Access Agreement (1) or Not (0) or Trade Incidence (1) or Not (0)

We first consider some simple correlations between the existance of an access agreement between a pair of countries (A_{ijt}) and stock status and the existence of fish trade between a pair of countries (T_{ijt}) and stock status:

$$\begin{aligned}
\Pr\left(A_{ijt}=1\right) &= \beta_0+\beta_1\frac{Fish\ status_i}{Fish\ status_j}+\varepsilon_{ijt} \\
\Pr\left(T_{ijt}=1\right) &= \beta_0+\beta_1\frac{Fish\ status_i}{Fish\ status_j}+\varepsilon_{ijt}
\end{aligned}$$

where i denotes the host country, j denotes the fishing country and t is the year. The variable $\dfrac{Fish\ status_i}{Fish\ status_j}$ is relative fish status and measures the fish status in the host country relative to status in the fishing country. We use our two measures of relative fish stock status throughout: mean tropic level (MTL) and mean maximum length (MML). The results are reported in Table 2. Interestingly in these simple correlations, relatively higher stock status in the host country is positively associated with having an access agreement but negatively associated with the incidence of fish trade from i to j.

4.1 International Fisheries Access Agreements

In our benchmark specification we consider the standard gravity variables used in the trade literature:

$$\Pr\left(A_{ijt}=1\right)=\beta_0+\beta_1\frac{Fish\ status_i}{Fish\ status_j}+\beta_2 X_{ij}+\beta_3 I_t+\beta_4 I_i+\beta_5 I_j+\varepsilon_{ijt} \qquad (1)$$

where X_{ij} includes the variables described in subsection 3.3. Anderson and van Wincoop (2003) emphasise the importance of controling for multilateral resistance in the gravity estimations, therefore, we include a full set of year, host and fishing country indicator variables (I_t, I_i, I_j).[15] As our dependent variable is a simple zero or one, our preferred empirical model is a probit. The results are reported in the first columns of Table 3. The last two columns of Table 3 show the results of a linear probability model instead.

In both specifications, the coefficient on the relative stock status variables are positive and significant. If statistically significant, the coefficients on the gravity variables are the same and typically as expected except that having a currency union is negatively correlated with having an agreement. The effect of GDP and GDP per capita in the host country, however, differs across specifications: under the probit, countries that are on aggregate economically larger but that are poorer per person are more likely to have agreements but the effect is the opposite under the linear probability model. Versions that included only GDP and not GDP per capita of host and fishing countries gave a negative coefficient on GDP of the host country so it seems that the effect of economic size is potentially made up of differing underlying characteristics.[16] In both specifications, countries that are economically smaller in the aggregate but are richer per person are more likely to be fishing countries. Probit models with fixed effects suffer from incidental parameters bias,

[15] The coefficients of the indicator variables are not reported but can be obtained from the authors upon request.

[16] We are currently exploring different datasets to try to tease out the effect of economic development as aggregate and per capita effects seem to be tangled here.

Table 3: Benchmark Gravity Specification

	Probit	Probit
MTL Host/MTL Fish	1.093***	
	(0.162)	
MML Host/MML Fish		0.230***
		(0.019)
Log GDP/cap Host	-0.018	-0.019
	(0.027)	(0.027)
Log GDP/cap Fishing	0.274***	0.287***
	(0.035)	(0.035)
Log Popn Host	1.025***	0.979***
	(0.107)	(0.106)
Log Popn Fishing	-2.362***	-2.313***
	(0.150)	(0.150)
Log Weighted Distance	-0.778***	-0.792***
	(0.018)	(0.018)
Maritime Border	0.031	0.028
	(0.036)	(0.036)
Log EEZ Host	0.125	0.097
	(0.068)	(0.068)
Log EEZ Fishing	1.674***	1.656***
	(0.093)	(0.093)
Same FTA	0.009	0.010
	(0.032)	(0.032)
Past Colony	-0.076	-0.084*
	(0.040)	(0.040)
Common Colonist	-0.124	-0.122
	(0.076)	(0.076)
Currency Union	-0.208*	-0.211*
	(0.087)	(0.087)
Common Legal	0.164***	0.162***
	(0.023)	(0.023)
Common Language	0.251***	0.265***
	(0.038)	(0.038)
Religion	-0.056	-0.064
	(0.041)	(0.041)
Constant	-8.624***	-7.540***
	(0.648)	(0.630)
Observations	244800	244800

Notes: Dependent Variable: Access Agreement (1) or Not (0).
A full set of year, host and fishing country dummies are included but coefficients are not reported.

Table 4: Notable Countries

	EU & FFA	EU & FFA	DWFN	DWFN
MTL Host/MTL Fish	1.161***		1.093***	
	(0.161)		(0.162)	
MML Host/MML Fish		0.235***		0.230***
		(0.019)		(0.019)
Log GDP/cap Host	-0.022	-0.022	-0.018	-0.019
	(0.027)	(0.027)	(0.027)	(0.027)
Log GDP/cap Fishing	0.274***	0.287***	0.274***	0.287***
	(0.034)	(0.035)	(0.035)	(0.035)
Log Popn Host	1.190***	1.143***	1.025***	0.979***
	(0.108)	(0.107)	(0.107)	(0.106)
Log Popn Fishing	-2.212***	-2.161***	-2.362***	-2.313***
	(0.152)	(0.152)	(0.150)	(0.150)
Log Weighted Distance	-0.788***	-0.801***	-0.778***	-0.792***
	(0.018)	(0.018)	(0.018)	(0.018)
Maritime Border	0.026	0.023	0.031	0.028
	(0.036)	(0.036)	(0.036)	(0.036)
Log EEZ Host	0.054	0.026	0.125	0.097
	(0.069)	(0.069)	(0.068)	(0.068)
Log EEZ Fishing	1.597***	1.577***	0.919***	0.938***
	(0.094)	(0.094)	(0.055)	(0.055)
Same FTA	-0.050	-0.049	0.009	0.010
	(0.033)	(0.033)	(0.032)	(0.032)
Past Colony	-0.082*	-0.090*	-0.076	-0.084*
	(0.040)	(0.040)	(0.040)	(0.040)
Common Colonist	-0.116	-0.115	-0.124	-0.122
	(0.076)	(0.076)	(0.076)	(0.076)
Currency Union	-0.198*	-0.202*	-0.208*	-0.211*
	(0.086)	(0.086)	(0.087)	(0.087)
Common Legal	0.170***	0.167***	0.164***	0.162***
	(0.024)	(0.024)	(0.023)	(0.023)
Common Language	0.246***	0.261***	0.251***	0.265***
	(0.038)	(0.038)	(0.038)	(0.038)
Religion	-0.054	-0.061	-0.056	-0.064
	(0.041)	(0.041)	(0.041)	(0.041)
EU Host	0.395***	0.399***		
	(0.051)	(0.051)		
EU Fishing	0.181***	0.174***		
	(0.033)	(0.033)		
FFA Host	0.066	0.070		
	(0.154)	(0.154)		
DWFN Dummy			3.103***	3.105***
			(0.218)	(0.218)
Constant	-8.643***	-7.494***	-4.957***	-4.047***
	(0.650)	(0.632)	(0.667)	(0.651)
Observations	244800	244800	244800	244800

Notes: Dependent Variable: Access Agreement (1) or Not (0).
A full set of year, host and fishing country dummies are included but coefficients are not reported.

thus the linear probability version is considered a check on the qualitative results. As our probit specification is not a true fixed effects model, because we use sets of indicator variables, and as the linear probability model generally gives qualitatively similar results (GDP excepted) we henceforth consider the probit specification only.

As discussed in Section 3.1 there are two important groups of countries: the European Union who negotiate as a group under the Common Fisheries Policy; and the Pacific Islands' Forum Fisheries Agency. In addition, there are five major distant water fishing nations (DWFN) - Japan, Russia, South Korea, Ukraine and USA - who send significant fleets to access fishing grounds in the high seas and other countries waters. We address these special countries in Table 4. The coefficients on these specific controls are as expected, the DWFN control for whether the j (fishing) country is one of these countries is particularly strong. All other variables retain the same sign and significance as the benchmark probit specification.

4.2 Endogeneity of Fish Stock Status

In our analysis thus far we have implicitly assumed that relatively high stock status in the host country compared to the fishing country is a determinant of whether an agreement exists or not. Some causality could, however, operate in reverse: having an agreement could mean more fishing is done and therefore could lead to a lower stock status in the host country. To address this issue we consider a variety of specifications starting with a simple set of lagged stock status variables and we then consider including a dummy variable if there was an agreement between a country pair in the previous year; the results of which are reported in Table 5. When the fish stock status is measured by mean trophic level five years prior, there is no statistically significant relationship with having an agreement but the other variables typically have the same signs and significance. If the measure of stock status is the mean maximum length the effect is still positive but is weaker. This suggests that

Table 5: Using Lagged Variables

	3-Yr Lag	3-Yr Lag	L.Agreement	L.Agreement
MTL Host/MTL Fish			0.619*	
			(0.242)	
MML Host/MML Fish				0.130***
				(0.029)
L3.MTL Host/MTL Fish	0.440**			
	(0.163)			
L3.MML Host/MML Fish		0.097***		
		(0.020)		
L.Agreement			3.257***	3.254***
			(0.029)	(0.029)
Log GDP/cap Host	-0.024	-0.024	0.041	0.041
	(0.028)	(0.028)	(0.040)	(0.040)
Log GDP/cap Fishing	0.253***	0.257***	0.171***	0.180***
	(0.036)	(0.036)	(0.047)	(0.047)
Log Popn Host	1.049***	1.039***	0.646***	0.626***
	(0.111)	(0.110)	(0.133)	(0.132)
Log Popn Fishing	-2.634***	-2.621***	-0.799***	-0.770***
	(0.162)	(0.161)	(0.186)	(0.187)
Log Weighted Distance	-0.809***	-0.813***	-0.505***	-0.512***
	(0.019)	(0.019)	(0.022)	(0.022)
Maritime Border	-0.013	-0.013	0.004	0.002
	(0.038)	(0.038)	(0.049)	(0.049)
Log EEZ Host	0.132	0.113	0.026	0.007
	(0.070)	(0.071)	(0.091)	(0.092)
Log EEZ Fishing	1.824***	1.836***	0.776***	0.786***
	(0.084)	(0.084)	(0.103)	(0.104)
Same FTA	-0.013	-0.012	-0.108*	-0.107*
	(0.034)	(0.034)	(0.049)	(0.049)
Past Colony	-0.100*	-0.103*	-0.099	-0.103
	(0.042)	(0.042)	(0.064)	(0.064)
Common Colonist	-0.040	-0.040	0.014	0.013
	(0.077)	(0.077)	(0.081)	(0.081)
Currency Union	-0.218*	-0.219*	-0.262*	-0.261*
	(0.089)	(0.089)	(0.117)	(0.116)
Common Legal	0.140***	0.139***	0.052	0.051
	(0.025)	(0.025)	(0.033)	(0.033)
Common Language	0.275***	0.281***	0.217***	0.224***
	(0.039)	(0.039)	(0.046)	(0.046)
Religion	-0.063	-0.066	0.030	0.027
	(0.043)	(0.043)	(0.060)	(0.060)
Constant	-7.160***	-6.802***	-6.635***	-6.394***
	(0.720)	(0.704)	(0.922)	(0.907)
Observations	218050	218050	236592	236592

Notes: Dependent Variable: Access Agreement (1) or Not (0).
A full set of year, host and fishing country dummies are included but coefficients are not reported.

this is some effect of earlier status.[17] When we control instead for having had an agreement in the previous period, this variable has a positive effect. This is not surprising given the multi-year agreements in place.[18]

An extremely interesting policy change for international fisheries (and other marine resources) occurred in 1982. The United Nations Convention on the Law of the Sea (1982), extended jurisdiction from a usual three to a 200 nautical mile exclusive economic zone (EEZ) around a nation. However, we observe multiple access agreements prior to 1982. This could be an indicator of historical relationship between host and fishing countries and so we use this information to create a dummy variable to explore this event:

$$\text{Agt Pre-1982} = \begin{cases} 1, & \text{if there was an agreement between } i \text{ and } j \text{ prior to 1982} \\ 0, & \text{otherwise} \end{cases}$$

An alternative approach is to simply allow for a general regime switch in 1982. We do this by creating a simple Post-1982 dummy variable:

$$\text{Post-1982} = \begin{cases} 1, & \text{if the year is } \geq 1982 \\ 0, & \text{otherwise} \end{cases}$$

The results of these estimations are reported in Table 6. Having an agreement prior to 1982 is positively associated with having an agreement at anytime, and means that the coefficient on sharing a maritime border is now positive. This suggests that historical fishing relationships are important determinants of current agreements. The Post-1982 variable is positive and significant. This is not unexpected as after 1982, countries that want to fish in previously international waters must arrange for the legal right to do this. Current relative stock status still plays an important role.

[17] As would be expected, versions with 1-year rather than 5-year lags were much closer to the benchmark specifications.

[18] Controlling for agreement length is noted as an item for further analysis.

Table 6: 1982 UNCLOS Considerations

	Agt Pre1982	Agt Pre1982	Post-1982	Post-1982
MTL Host/MTL Fish	0.985***		1.093***	
	(0.176)		(0.162)	
MML Host/MML Fish		0.192***		0.230***
		(0.020)		(0.019)
Agt Pre-1982	1.878***	1.873***		
	(0.028)	(0.028)		
Post-1982			1.840***	1.816***
			(0.218)	(0.218)
Log GDP/cap Host	-0.007	-0.006	-0.018	-0.019
	(0.030)	(0.030)	(0.027)	(0.027)
Log GDP/cap Fishing	0.292***	0.303***	0.274***	0.287***
	(0.040)	(0.040)	(0.035)	(0.035)
Log Popn Host	0.903***	0.860***	1.025***	0.979***
	(0.119)	(0.118)	(0.107)	(0.106)
Log Popn Fishing	-2.702***	-2.656***	-2.362***	-2.313***
	(0.173)	(0.172)	(0.150)	(0.150)
Log Weighted Distance	-0.578***	-0.590***	-0.778***	-0.792***
	(0.019)	(0.019)	(0.018)	(0.018)
Maritime Border	0.080*	0.074	0.031	0.028
	(0.039)	(0.039)	(0.036)	(0.036)
Log EEZ Host	-0.319***	-0.339***	0.125	0.097
	(0.069)	(0.069)	(0.068)	(0.068)
Log EEZ Fishing	1.305***	1.319***	1.674***	1.656***
	(0.085)	(0.085)	(0.093)	(0.093)
Same FTA	-0.457***	-0.456***	0.009	0.010
	(0.040)	(0.040)	(0.032)	(0.032)
Past Colony	-0.127**	-0.133**	-0.076	-0.084*
	(0.047)	(0.047)	(0.040)	(0.040)
Common Colonist	-0.130	-0.129	-0.124	-0.122
	(0.075)	(0.075)	(0.076)	(0.076)
Currency Union	-0.392***	-0.392***	-0.208*	-0.211*
	(0.090)	(0.090)	(0.087)	(0.087)
Common Legal	0.270***	0.267***	0.164***	0.162***
	(0.025)	(0.025)	(0.023)	(0.023)
Common Language	0.232***	0.243***	0.251***	0.265***
	(0.037)	(0.037)	(0.038)	(0.038)
Religion	-0.093*	-0.099*	-0.056	-0.064
	(0.042)	(0.042)	(0.041)	(0.041)
Constant	-4.425***	-3.599***	-8.624***	-7.540***
	(0.696)	(0.678)	(0.648)	(0.630)
Observations	244800	244800	244800	244800

Notes: Dependent Variable: Access Agreement (1) or Not (0).
A full set of year, host and fishing country dummies are included but coefficients are not reported.

4.3 Bilateral Trade in Fish Products

In this section, we take advantage of the incorporation of data on bilateral trade in fish products to consider the determinants of fisheries access agreements compared to fish product trade.

First, we estimate the specification similar to Equation 1 except that the dependent variable is a dummy that indicates if there is a positive bilateral trade flow in fish-related products between countries i and j in year t. The results are reported in Table 7. The relative stock status variables are now, compared to the simple correlations presented in Table 2, positively associated with trade incidence. The coefficients from the probit specification are, however, smaller in magnitude than for agreements as presented in Table 3. In comparison to the negative effect that sharing a currency had on agreement probability, it is now positively associated with trade. Other measures of cultural closeness - past colony, common colonist and religion - that had no statistically significant impact on agreements have a positive relationship with trade. The effect of GDP and GDP per capita is now the same across specifications and indicates that host countries that economically large but poor per capita and fishing countries that are economically small but rich per capita are more likely to trade with each other.

We then take advantage of the fuller trade data available and consider the determinants of trade value rather than simple incidence. The results in Table 8 indicate that relative stock status is positively related to trade value and that the other gravity variables are statistically significant and have expected coefficients. GDP per capita is, perhaps, one exception. The standard gravity model does not include GPD per capita, we have it here to capture relative richness of the country partners. Interestingly, the coefficient is negative for both host and fishing countries getting richer which could be from a move away from the agricultural sector in production and away from fish in consumption.[19]

[19] While fish is often considered expensive in rich countries, it is the main source of animal protein

Table 7: Fish Products Trade Incidence

	Probit	Probit
MTL Host/MTL Fish	0.507***	
	(0.080)	
MML Host/MML Fish		0.050***
		(0.014)
Log GDP/cap Host	0.139***	0.138***
	(0.013)	(0.013)
Log GDP/cap Fishing	0.492***	0.489***
	(0.013)	(0.013)
Log Popn Host	1.130***	1.118***
	(0.047)	(0.047)
Log Popn Fishing	-0.688***	-0.679***
	(0.044)	(0.044)
Log Weighted Distance	-0.605***	-0.605***
	(0.009)	(0.009)
Maritime Border	-0.132***	-0.131***
	(0.028)	(0.028)
Log EEZ Host	0.131***	0.140***
	(0.033)	(0.033)
Log EEZ Fishing	0.625***	0.625***
	(0.029)	(0.029)
Same FTA	-0.187***	-0.187***
	(0.027)	(0.027)
Past Colony	0.729***	0.728***
	(0.031)	(0.031)
Common Colonist	0.126***	0.126***
	(0.028)	(0.028)
Currency Union	0.444***	0.440***
	(0.048)	(0.048)
Common Legal	0.211***	0.211***
	(0.012)	(0.012)
Common Language	0.143***	0.145***
	(0.018)	(0.018)
Religion	0.210***	0.210***
	(0.026)	(0.026)
Constant	-8.334***	-7.901***
	(0.267)	(0.255)
Observations	209489	209489

Notes: Dependent Variable: Trade Incidence (1) or Not (0).
A full set of year, host and fishing country dummies are included but coefficients are not reported.

Table 8: Fish Products Trade and UN Considerations

	Agt Pre1982	Agt Pre1982	Post-1982	Post-1982
MTL Host/MTL Fish	0.507***		0.507***	
	(0.080)		(0.080)	
MML Host/MML Fish		0.050***		0.050***
		(0.014)		(0.014)
Agt Pre-1982	0.084***	0.084***		
	(0.020)	(0.020)		
Post-1982			-0.857***	-0.788***
			(0.062)	(0.062)
Log GDP/cap Host	0.138***	0.138***	0.139***	0.138***
	(0.013)	(0.013)	(0.013)	(0.013)
Log GDP/cap Fishing	0.491***	0.488***	0.492***	0.489***
	(0.013)	(0.013)	(0.013)	(0.013)
Log Popn Host	1.123***	1.112***	1.130***	1.118***
	(0.047)	(0.047)	(0.047)	(0.047)
Log Popn Fishing	-0.695***	-0.686***	-0.688***	-0.679***
	(0.044)	(0.044)	(0.044)	(0.044)
Log Weighted Distance	-0.598***	-0.598***	-0.605***	-0.605***
	(0.009)	(0.009)	(0.009)	(0.009)
Maritime Border	-0.134***	-0.133***	-0.132***	-0.131***
	(0.028)	(0.028)	(0.028)	(0.028)
Log EEZ Host	0.110***	0.106***	0.131***	0.140***
	(0.031)	(0.031)	(0.033)	(0.033)
Log EEZ Fishing	0.606***	0.607***	0.625***	0.625***
	(0.029)	(0.029)	(0.029)	(0.029)
Same FTA	-0.209***	-0.209***	-0.187***	-0.187***
	(0.028)	(0.028)	(0.027)	(0.027)
Past Colony	0.731***	0.730***	0.729***	0.728***
	(0.032)	(0.031)	(0.031)	(0.031)
Common Colonist	0.121***	0.122***	0.126***	0.126***
	(0.028)	(0.028)	(0.028)	(0.028)
Currency Union	0.441***	0.437***	0.444***	0.440***
	(0.048)	(0.048)	(0.048)	(0.048)
Common Legal	0.211***	0.211***	0.211***	0.211***
	(0.012)	(0.012)	(0.012)	(0.012)
Common Language	0.146***	0.147***	0.143***	0.145***
	(0.018)	(0.018)	(0.018)	(0.018)
Religion	0.208***	0.208***	0.210***	0.210***
	(0.025)	(0.025)	(0.026)	(0.026)
Constant	-8.119***	-7.622***	-8.334***	-7.901***
	(0.300)	(0.287)	(0.267)	(0.255)
Observations	209489	209489	209489	209489

Notes: Dependent Variable: Trade Incidence (1) or Not (0).
A full set of year, host and fishing country dummies are included but coefficients are not reported.

In our final specification we allow for the existence of access agreements and fish trade incidence to be jointly determined by relative stock status and gravity characteristics. In particular, we consider a bivariate probit model, the results of which are presented in Table **??**. The estimates are consistent with the findings from the separate regression: relative stock status matters, but less for trade; GDP and GDP per capita have different effects for host and fishing countries; cultural closeness matters for trade but not agreements; being part of a currency union has opposite effects for agreements and trade; and free trade areas and sharing maritime borders are negatively correlated with trade but not agreements.

5 Conclusion

This paper uses a unique dataset on international fisheries access agreements to empirically consider the characteristics that determine which countries make agreements with each other and compare this with the determinants of fish trade flows. We find that relative fish stock status is an important determinant of both access agreements and fish trade, although more so for agreements. The effects of standard gravity measures of closeness are less important for access agreements but measures of cultural closeness, in particular, are strongly correlated with fish trade. The impact of economic size and per capita income are different for host versus fishing countries, suggesting that economically larger but poorer countries are providing fish to economically smaller but richer consumers via either access agreements or trade. While consideration of the terms of these access agreements, or of trade, are not able to be considered here, the complementarity of these mechanisms suggests that work considering the most appropriate options for relatively resource rich, but economically poorer, to reap the gains from their resources would be rewarding and important.

for one-fifth of the world's population (FAO 2010).

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