When will trade restrictions affect producer behavior:

Oligopsony power in international trade

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Abstract

In recent years an increasingly common feature in international trade is cases where an importing country finds production practices in exporting countries unacceptable, and where one seeks to change these practices by imposing trade restrictions. Examples include unacceptable environmental practices, anti-dumping, child labour and social dumping. Trade measures implemented to influence such practices depend on the importer's degree of market power to be effective. In particular, they will have no effect if the importing country does not have oligopsony power. We derive a residual supply schedule to investigate the degree of oligopsony power in an international trade setting. This allows a test of whether the measures will have an impact before they are implemented. An empirical application is provided for U.S. swordfish imports, and the results indicate that the U.S. has market power against three of the six countries investigated.

Keywords: Oligopsony, residual supply, trade

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Introduction

In recent years an increasingly common feature in international trade is cases where an importing country finds production practices in exporting countries unacceptable, and where one seeks to change these practices by imposing trade restrictions. One example why import restrictions are implemented is environmental concerns, such as the US dolphin and turtle safe cases.[1] The US now requires that imported tuna and shrimp must be harvested with dolphin-safe and turtle-safe devices, respectively, for exporters to have access to the US market. However, these measures will only change the fishermen's behavior and have a positive environmental effect if the US influences the traded prices of wild-caught shrimp and tuna. If the fishermen can shift their product to other markets, the import restrictions will have little or no effect. Hence, the exporter will not undertake costly behavioral changes unless given adequate economic incentives. In practice this means that the effectiveness of trade restricting measures in improving production practices in exporting countries depends on the importer's capability of reducing the exporters' profitability. Effective trade measures to change exporter behavior thus require that the importer has oligopsony power with respect to the exporter. This also implies that the potential effect of trade measures can be tested before implementation by testing whether and to what degree the importing country have market power.

In addition to environmental concerns, there are also several other reasons why imports are restricted due to unacceptable production practices. During recent decades, there has been an

[1] More information about these cases can be found in Wessells and Wallström (1994), Robb (2001), and Teisl, Roe and Hicks (2002).

increase in anti-dumping cases where named exporters, when found guilty, have had to pay an anti-dumping duty to access the market (Prusa, 1996). The main goal of the dumping measures is to raise prices in the domestic market to a “fair” level. Whether there is a price effect due to the measures, however, depends on whether the country that imposes the restrictions has market power against the group of named producers. If not, the main effect of the measures will be a reallocation of trade patterns, as has been the case for US import restrictions on salmon and shrimp (Asche, 2001; Keithly and Poudel, 2008). Import restrictions have been implemented to stop the use of child labor, which is a case of so-called social dumping, and in war financing as with dirty diamonds. Austvik (1997) indicates that increased energy taxes among importers of oil have the potential to transfer resource rent from producer to consumer countries. The common feature of these measures is that if an importer does not have oligopsony power, there is no reason to believe the measures will have any effect.

In his seminal paper, Lerner (1934) related the firm’s market power to the slope of the demand schedule facing the individual firm, the residual demand curve. Goldberg and Knetter (1999) show how this can be used to investigate whether an exporting country has market power.[2] They also show that an advantage in the international trade setting is that exchange rates will provide powerful instruments. To measure the degree of oligopsony power for a country we use a similar notion; the residual supply schedule. In section 2 we derive the residual supply curve in an international trade context formally, largely following Goldberg and Knetter (1999). Our model is related to Durham and Sexton’s (1992) model of a residual supply curve for an individual firm in a similar way as Goldberg and Knetter’s (1999) model is related to Baker and Bresnahan (1988). The main difference is how variables related to

[2] Exploitation of market power on a country basis in international trade is known as Pricing-to-market (PTM) (Krugman, 1987; Knetter, 1993; Goldberg and Knetter, 1999).

international trade, and particularly exchange rates and the possibility to trade with other countries are included.

A graphical representation is a useful starting point. The residual supply curve that faces an importing country depicts how a country influences the input price through the quantity it purchases. To derive the residual supply we have to take into account the total supply and the derived demand of all other importers of the product. This is illustrated in Figure 1. The left panel shows the total market supply, S, and the derived demand from all other countries buying the product in question, D_{other}. The residual supply $S_{residual}$ shown in the right panel is then given by the difference between market supply and other firms' derived demand. The elasticity of the residual supply curve depends both on the market supply and the other countries' derived demand. With competitive demand for the product, the price is completely determined by the other countries' derived demand. In this case, the residual supply curve will be flat, and an import restriction will not have any effect on the price to the exporter. An upward-sloping supply curve implies that the country of interest has some oligopsony power.[3] If the country will maximize profits, for instance to obtain a maximum rent transfer, the country can act as a monopsonist on the marginal expenditure curve (ME), giving the price P*. When the residual supply curve and the market supply curve coincide, i.e., have the same slope, the country will be a monopsonist. Also for an oligopsonist the degree of market power can be measured by a Lerner type of index.

An interesting result immediately evident from the figures is that if the suppliers are perfectly competitive, there is no scope to exploit oligopsony power. This is because a horizontal

[3] Note that this does not imply that individual importers in the importing country have oligopsony power. It is changes in aggregate imports that influence the exporter's price. As a result, this can be exploited by introducing trade measures that serve to 'coordinate' the importers in reducing the quantity imported. Trade measures as a coordination mechanism was discussed by Steen and Salvanes (1999).

market supply schedule also gives a flat residual supply curve. Because strong competition leads to a responsive supply, it is more likely with a highly elastic supply than a highly elastic aggregate consumer demand.[4] Consequently there are fewer opportunities to exploit market power for a buyer than for a seller. Many internationally traded commodities, for example, are characterized by competitive supply, at least within regions. This is particularly true in international markets for primary commodities products where suppliers from a number of countries compete.

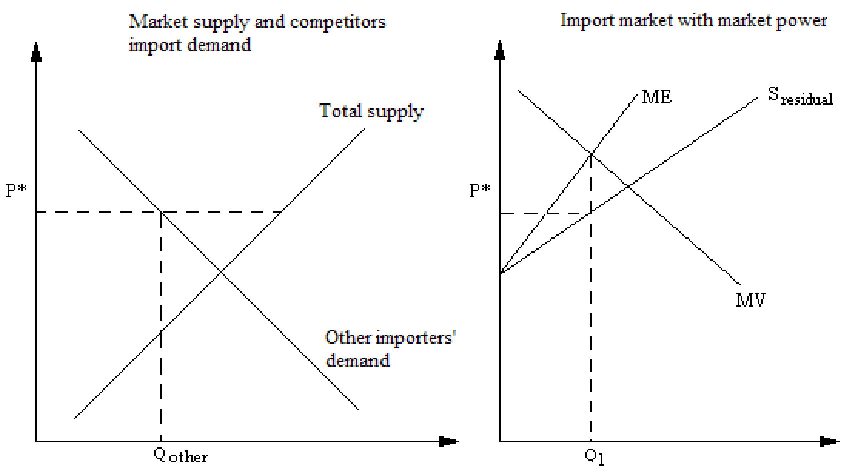

Figure 1. Market Supply and Residual Supply of Intermediate Good *M*

To test for oligopsony power, a residual supply schedule provides a single equation that can be easily estimated when given a functional form. This provides a different approach to testing for oligopsony power than the specifications of Schroeter (1988) and Morrison Paul

[4] Diminishing marginal utility and budget constraints make consumer demand for all products downward sloping and accordingly provide an opportunity for a seller to exploit market power. Hence, while it suffices to face limited competition in the sale to exploit market power for a seller, buyer power requires both limited competition from other buyers and an upward sloping supply schedule from the providers of the product in question. This also increase the scope for exploiting buyer power in the short run, as quasi-fixed input factors make supply less elastic.

(2001), who specified the markup equation together with a full cost function specification similar to the approach of Appelbaum (1981). Schroeter, Azzam and Zhang (2000) used the model of Bresnahan (1982) and Lau (1982). The fact that a residual supply schedule can be estimated as a single equation linear in its parameters will in many cases make it an easier specification to use in empirical work. The specification is independent of the assumptions about market structures in other markets, and any behavior on the buyer side from a competitive situation to a monopsony can be identified. Moreover, the inputs can be differentiated, a feature that can be important in international trade as many products are differentiated by origin. Finally, estimating the residual supply curve does not require the conduct parameters to be estimated, and one accordingly avoids the issues addressed by Corts (1999).

We will estimate residual supply equations for leading exporters of swordfish to the USA. There have been campaigns against current management practices that may well lead to swordfish being the next seafood species for which imports to the US are conditional on the fishing practices of the supplier. The adoption of 'cleaner' catch technology in exporting countries can be costly and difficult to implement (Hogan, 2004). As a result, some kind of economic support or sanction scheme must be used to induce the desired behavioral changes. We test whether the US has market power over the imports of swordfish from Brazil, Costa Rica, Chile, Mexico, Trinidad and Tobago and Uruguay. This is accordingly an example of a test of whether import regulations are effective as a means to improve environmental conditions in a foreign country. This will be the case only if the importing country has oligopsony power in its imports of the product. Our results show that the US has oligopsony power relative to some of these trading partners, but not in the relationships with Brazil and Mexico. Hence, if changing fishing practices is costly to fishermen in Brazil and Mexico, they will merely reallocate swordfish exports to other markets if the US imposes environmental requirements. In the other countries, import restrictions will give incentives for improved fishing practices.

Model

In this section we derive a model for a particular country's residual supply, which is the basic tool used here to investigate buyer power. Durham and Sexton (1992) derived a residual supply model for the homogenous product tomatoes, where different spatial locations were the potential source of market power. Our model therefore also has elements from Baker and Bresnahan's (1988) model of residual demand, and allows the input factors to be differentiated. The adoptions necessary to account for the international trade situations are similar to those employed by Goldberg and Knetter (1999) when deriving a residual demand curve in similar circumstances.

The inverse supply function for an exporter (or intermediate good *M*) facing importing country 1, the country of interest, is

$$w^{im} = W^{im}(Q^{im}, w_2, ...w_n, V^s)\,. \qquad (1)$$

where w^{im} and Q^{im} are country 1's import price in the exporter's currency and quantity, $w^2,\ldots w^n$ is a vector of import prices to other countries of the good in the exporters' currencies, and V^s is a vector of exogenous variables entering the supply equation, typically the supplier's input prices in the exporter's currency. Correspondingly, we can formulate the inverse supply facing each of the other importers of good *M*, $i = 2,\ldots,N$, as

$$w^i = W^i(Q^i, w^j, w^{im}, V^s)\,. \qquad (2)$$

Goldberg and Knetter (1999) provide a discussion of how the export industry's first order conditions can be derived for a specific firm. A similar procedure is used here. As the object of interest is the import demand of a country, one can, by assuming the appropriate aggregation conditions are fulfilled, just pose the importer's problem. For every exporter, import demand for the good can be found by solving the profit maximizing problem:

$$\underset{Q_i^{im}}{Max}\, \Pi_i^{im} = epf(Q^{im}, z) - w^{im} Q^{im} - erz \tag{3}$$

where e is the exchange rate, p is the importer's sales price of the good in domestic currency, $f(\cdot)$ is the production function, z is a vector of quantities of other input factors (e.g. marketing costs) and r their prices in the domestic currency. The first order conditions imply that the marginal revenue product (*MRP*) is set equal to the perceived marginal expenditure (*PME*). The *MRP* shows the additional value that the importing country attach to a marginal increase in import of the product, and is found by taking the derivative of the first term on the right hand side of (3) with respect to the imported quantity, Q^{im}. Likewise, the *PME* shows the additional outlay following a marginal increase in imports, and is found by taking the derivative of the second term on the right hand side. Since *PME* depends on the importing country's conjectures concerning the response from other importers, it is perceived, rather than actual, marginal expenditure. By solving equation 3, the first order condition can be written as:

$$w^{im} = e \cdot MRP^{im} - Q^{im} \sum_j \left(\frac{\partial W^{im}}{\partial w^j} \right) \left(\frac{\partial w^j}{\partial Q^{im}} \right). \tag{4}$$

The degree of market power is determined by the last parenthesis, which is often denoted by a conduct parameter λ^{im}. The conduct parameter λ^{im} shows the conjectures about the impact on other countries' import prices of increased demand from the country of interest, $\partial W^j / \partial Q^{im}$. A similar expression can be found for all other countries importing the good:

$$w^i = e^i MRP^i(p^i, r^i) - Q^i \sum_j \left(\frac{\partial w^i}{\partial w^j}\right)\left(\frac{\partial w^j}{\partial Q^i}\right), \qquad (5)$$

for $i = 1,\ldots,K$. Solving the equations defined by (2) and (4), one obtains the import prices in the competing import countries as functions of the supply and demand shifters, and the imported quantity. Using vectors notation, this is given as

$$w^i = E^I(Q^{im}, V^s, eR, eP, \lambda^I), \qquad (6)$$

where E^I is the equilibrium quantity for all markets except for the market of interest, and all right-hand side variables but Q^{im} are exogenous. Equation (6) can therefore be denoted as a partially reduced form.

By substituting from equation (6) into (1), one obtains the residual supply relationship facing the country of interest

$$w^{im} = W^{im}(Q^{im}, E^I(Q^{im}, V^s, e\mathrm{R}, eP, \lambda^I), V^s). \qquad (7)$$

Substituting out the redundancies, this gives the residual supply curve facing the country of interest.

$$w^{im} = S^{res,im}(Q^{im}, V^s, e\mathrm{R}, eP; \lambda^I) \qquad (8)$$

The residual supply curve is a function of the demanded quantity of the import good, the supply shifters V^s, and the demand shifters for other countries buying the good, which are divided into their sales price *eP* and the price for their input factors *eR*. The output price, other input factor prices and the exchange rate for the import country are not included in this equation and will serve as instruments for the endogenous quantity Q^{im}.

The key parameter of interest is the inverse residual supply elasticity, or the residual supply flexibility

$$\kappa = \frac{\partial \ln S}{\partial \ln Q^{im}} \, . \tag{9}$$

This elasticity will be zero if the demanded quantity of from the import country does not influence the import price and the importing country does not have any market power. The elasticity increases in magnitude as the market power of the importing country increases.

As the model is formulated at the country level one can, of course, provide criteria that give consistent aggregation as in Appelbaum (1982), or one can interpret the estimated parameters as industry averages as in Goldberg and Knetter (1999). In this, Golberg and Knetter (1999) are typical representatives of the Pricing-To-Market literature, where exporting and importing countries are the unit of analysis. In general when using aggregated data, little focus is given to whether the aggregation criterion is met. What matters in relation to trade policy is that trade measures can be interpreted as coordinated actions by the importing firms in a country. This also applies in the case of import measures, as these are typically levied on all exporters from a given country. We will not elaborate further on this issue here, but only note that the models can be used on aggregate data to test whether groups of firms have market power if one is willing to assume that an aggregation criterion holds or to make interpretations based directly on the aggregated data.

As noted by Goldberg and Knetter (1999), there is, in general, substantially more variation in the exchange rates than in factor prices and other cost variables and this is also true for variables influencing revenue. With functional forms like a double log, where it is reasonable to separate the exchange rates from the prices, the exchange rates may provide a very good indicator of changes in marginal costs or import demand even if input price data are not available. It may also be reasonable to treat the exporter as a revenue maximizer, basically modeling the supply as a trade allocation.[5] If so, all supply variables can be obtained from the exporter country's trade statistics.

Measuring the degree of market power

When investigating the degree of market power for a monopolist or oligopsonist, a Lerner index is the most common measure. Similar measures are equally useful to measure the degree of monopsony or oligopsony power. Let the import industry in a country be able to exercise market power for an imported intermediate product *m*. For simplicity we assume that the firms use the intermediate good in the production of one output only. With the production function $f(x_1, x_2, .., x_{n,})$, where the imported product *m* is one of the inputs, the degree of market power with respect to *m* is given by

$$\frac{epf_m - w_m}{w_m} = \frac{1}{\eta}, \tag{10}$$

where η is the supply elasticity faced by the importing country, *p* is the output price and w_m is the input price for input *m*. The markdown is here decided by how much lower than the marginal value product of the factor the factor price w_m is. If the country's importing firms face an infinitely elastic supply curve, the difference between the marginal value product, epf_m, for factor *m* and its price is zero. Moreover, as the supply elasticity decreases, the difference between the marginal value product and the price increases as the price is reduced relative to the marginal value product.

For an oligopsonist, there are two different ways to express the degree of market power using this index. In the first, the oligopsonist's degree of market power is expressed as a function of

[5] See e.g. Dixit and Norman (1980) for a discussion of the use of revenue functions to model trade allocation.

the total supply elasticity and a conduct parameter measuring the degree of competition the firms in question face. The index is then

$$\frac{epf_m - w_m}{w_m} = \frac{\theta_1}{\eta}, \tag{11}$$

where θ_1 is the conduct parameter that indicates the degree of competition among buyers. Alternatively, since the oligopsonists will operate as a monopsonist on the residual supply curve, the degree of market power can be expressed as

$$\frac{epf_m - w_m}{w_m} = \frac{1}{\mathrm{K}} = \kappa, \tag{12}$$

where K is the residual supply elasticity and κ is the inverse residual supply elasticity defined in equation (9).

Another way to derive the inverse residual supply elasticity is by differentiating equation (8) with respect to importing country 1's quantity Q_1. This shows that the inverse residual supply elasticity can be formulated as a sum of elasticities that consist of direct and indirect effects on residual supply caused by changes in importing country 1's derived demand.

$$\kappa = \frac{\partial \ln S_1^{res}}{\partial \ln Q_1} = \frac{\partial \ln S_1}{\partial \ln Q_1} + \sum_i \frac{\partial \ln S_1}{\partial \ln W_i} \cdot \frac{\partial \ln W_i}{\partial \ln Q_1}. \tag{13}$$

The first term on the right-hand side is the supply elasticity, $\partial \ln S_1 / \partial \ln Q_1$. The two remaining terms sum the effects of strategic interaction with firms in other importing countries, $i = 1, ..., N$. The term $\partial \ln W_i / \partial \ln Q_1$ represents the change in prices paid by other importing countries as a result of importing country 1's increased purchases. This term is positive when firms in the different countries compete in purchases of the intermediate good and otherwise zero. Competition will reduce the supply facing importing country 1 through a negative term $\partial \ln S_1 / \partial \ln W_1 < 0,$ because other importing countries divert supply away from importing country 1 when firms there offer higher prices. Consequently, the residual supply curve will become flatter with increasing intensity of competition among importers.

In the case of residual demand, Baker and Bresnahan (1988) show that the residual demand elasticity provides an exact measure of the markup if the conjectures are consistent. This is the case also in an oligopsony. Hence, the residual supply elasticity provides an exact measure of the markdown if the importing country's conjectures about the responses of firms in other importing countries are consistent. In particular, this is the case if purchases of the factor are competitive, as the term $\partial \ln W_i / \partial \ln Q_1$ is then zero. A test of whether the residual supply elasticity is zero is always a valid test of whether importing country 1 has market power. In other cases, one will expect a steeper residual supply curve to indicate more market power also in cases when conjectures are not consistent.

Background and Data

During the last decades the production process for imported goods have received increased attention in the US and Europe. There are also several cases where imports are restricted because the production processes in the foreign country are regarded as unacceptable. The process that leads to import restrictions is usually started by some interest group pointing at the problematic practice. If the concern has a wider appeal, increased support can lead to political motions to address the issue. Two environmental concerns that have been addressed this way in the US, and where import restrictions have been implemented, are the dolphin safe tuna (Wessells and Wallström, 1994; Teisl, Roe and Hicks, 2002) and the turtle safe shrimp cases (Robb, 2001).

More recently, there have been initiatives in the US to reduce imports of swordfish because of poor environmental practices in many swordfish fisheries. Initiated in 1998, *Give Swordfish a Break*[6] was a public relations campaign of SeaWeb and the National Resources Defense Council in the US targeting chefs and consumers to refrain from buying swordfish to support stronger swordfish conservation. The first phase lasted until August 2000 when (a temporary) victory was declared when the US government supported stronger harvest quota restrictions among member nations of the International Convention on the Conservation of Atlantic Tunas (ICCAT). However, after a short period of lower activity, campaigning continued, and WWF claims that some trawlers catch three metric tones of shark for each metric ton of swordfish.

The US is the world's largest importer of swordfish, and the US imports make up over 40% of global imports of fresh swordfish (FAO Fishstat). The other main import markets are Japan and Spain. The swordfish market is segmented as indicated by Figure 2, where the export prices for six large exporters are shown. As one can see, price levels differ substantially indicating different qualities. Moreover, as fresh swordfish is a highly perishable product, the fish is mostly air freighted and transportation costs are also significant.

We will investigate the potential market power of the US vis-à-vis six large exporters; Mexico, Brazil, Chile, Uruguay, Costa Rica and Trinidad and Tobago. These countries are the largest exporters which consistently ship to the US (a few missing observations are interpolated). Other significant exporters in some years, like Australia, Canada and Taiwan, are virtually not shipping to the US in other years. Hence, although quantities from these countries in periods are significant, the US potential to exploit market power is highly limited, as these countries have alternative markets.

[6] http://www.seaweb.org/programs/swordfish/10.3.02.release.html.

Quarterly data on import quantity and price for fresh swordfish are obtained from NOAA Fisheries' trade statistics. The data span the period 1996 to 2004. These are the main variables of interest in our model. As export supply shifters we use measures that proxy vessel fuel costs, swordfish biomass and wage costs. Gasoil price is used as measure of vessel fuel costs, which has been collected from the oil company Statoil. Annual data on swordfish catch by oceanic region from FAO is used to represent available biomass. This is an important variable because a lower biomass will increase the fishermen's search cost. Finally, we use wage indices collected from the various countries' national statistical bureaus as a measure of wage costs. As demand shifters, we use wholesale prices for two major swordfish-importing countries, Japan and Spain, in the importers currency. The wholesale prices are from the Tsukiji market in Japan and Mercamadrid market in Spain and were obtained from the Norwegian Seafood Export Council. In addition, exchange rates are used between the importing and the exporting country from Oanda.com. To identify the residual supply curve, imported quantity must be instrumented by variables that shift US demand. For this purpose we use US retail price of fresh swordfish from Urner Barry, swordfish catches in the US and the exchange rate between USD and the exporting country's currency.

Empirical results

To test for market power exertion, we specify a residual supply schedule where the variables are linear in logarithms, and consequently, the estimated parameters can be directly interpreted as elasticities. The model takes the following form:

$$\ln w_t = \alpha + \kappa\, q_t + \beta\, V_t^s + \gamma\, Z_t + \varepsilon_t \qquad (14)$$

where ε_t is an iid error term, and t denotes time period (quarter). The variable w_t is the import price denoted in the exporting country's currency, and q_t is the quantity purchased.

The vector V_t^s consists of exogenous variables shifting the supply of swordfish in the source country, the gasoil price, the wage rate and the total catch and Z_t is a vector of wholesale prices in other countries that are alternative markets to the US and their exchange rates relatively to the exporter.[7,8] These alternative markets are Japan and Spain, the two largest importers of swordfish in the world besides the US.

The equations are estimated with a GMM/IV procedure, and since autocorrelation was a problem, Newey–West standard errors are reported. The autocorrelation consistent standard errors and covariance are based on a Bartlett kernel with bandwidth two. We instrument the quantity with the retail sales price in the US, the exchange rate and lagged values of quantity and retail price.[9] We tested for over-identification using the Hansen J-test, and the test statistics suggest that over-identification is not a problem in any of the equations. In addition we calculate the statistics for the Anderson canonical correlations likelihood-ratio test for under-identification. The Anderson LR test determines if the excluded instruments are relevant. The test indicates that all but one model are identified; the null of under-identification is not rejected for Trinidad and Tobago.

The results are reported in Table 2. The explanatory power of the models is quite good with the exception of Trinidad & Tobago where it is a low as 0.265. For the other countries the R^2 varies from 0.741 to 0.977. Many of the exogenous variables are statistically significant at a 5% level, and in all equations there is at least one cost and one demand shifter that is statistically significant.

[7] The total catch is in metric tones, and can as such be regarded as a fixed factor. This is because the stock will limit catches.
[8] For Costa Rica we were not able to obtain wages, and this variable is therefore missing for Costa Rica.
[9] We have also estimated the equation with a dummy for the Give Swordfish a Break campaign as an additional instrument. These results are not reported as they did not differ from the reported results.

The key parameter of interest, the residual supply flexibility is reported in the fist row. As one can see, for Chile, Costa Rica and Uruguay estimates are statistically significant, while they are not statistically significant for Brazil, Mexico and Trinidad and Tobago. For the three countries were the elasticity is statistically significant, the magnitude is not very large as it varies between 0.072 and 0.142. That is, if one assumes consistent conjectures, the mark-down is between 7.2% and 14.2%. Hence, US trade restrictions on imports from Chile, Costa Rica and Uruguay are likely to influence fishing practices. However, the effect is not likely to be very large. The magnitude for Trinidad and Tobago indicates a positive mark-down of about 7%, but it is not statistically significant. As the model for Trinidad and Tobago does perform poorly compared with the models for the other countries, the results are consequently not very reliable. Although the elasticity is statistically insignificant, it is there for difficult to make a clear conclusion with respect to Trinidad and Tobago. For Uruguay the magnitude is the highest, at 0.142, and trade restriction would be significantly more potent. Somewhat surprisingly, Mexico, the country with the closest proximity to the US is one of the two countries where the US does not seem to have market power. The significant effect of the Japanese and Spanish demand shifters appears to be the main reason, as these markets seem to be viable alternatives for Mexican exporters. For Brazil, the estimated parameter is negative, but basically zero. Hence, US trade measures are not likely to influence fishing practices in these two countries. The main reason for this is most likely the fact that the larger economies of Brazil and Mexico lead them to be better connected to other countries than the USA. As such, it is distance as measured by transportation costs, not kilometers that is most important.

Concluding remarks

The exploitation of oligopsony power has become an increasingly interesting topic in international trade as there is an increasing use of trade measures to influence exporters' behavior or production techniques. Trade measures are imposed against other countries because their production practices are perceived as unacceptable or unfair. This includes measures due to environmental and social concerns as well as for anti-dumping. These measures have in common that their effect depends on the importers' degree of market power. In particular, the measures will have no effect if the importer does not have market power, as the exporters hit by the regulations then just shift their exports to other markets. In this paper, we derive a residual supply schedule to investigate the degree of oligopsony power in an international trade context. Using this approach, one can test whether trade restricting measures against an industry in a foreign country will have any effect before they are implemented.

An empirical application is provided analyzing whether the US is in a position to affect the fishing practices of swordfish by imposing requirements on fishing practices of their suppliers. The rationale is that if the US authorities wish to induce a change in fishermen's behavior they must incur profit reductions of the swordfish exporters in the targeted country,. It is thus implied that the profit functions of exporters and fishermen are interrelated. For most swordfish fisheries this will be a realistic assumption as the prices the fishermen obtain depend on those of the exporters. This trade issue was analyzed by estimating whether the US has oligopsonistic power as an importer of swordfish from six major exporters. We find that the US has market power in the swordfish import market for three of the six countries, and therefore conclude that fishing practice requirements imposed by the US on suppliers of swordfish can affect the conduct of the fishermen. Consequently, potential trade restrictions may in some of the cases have the desired environmental effect, given that the effect on exporters' profitability is sufficiently severe.

Two issues that are of interest for further research, but which is not addressed here is the effect of limiting the imports from a group of countries simultaneously, and limiting the imports to several markets simultaneously. Both measures are likely to increase the effectiveness of the trade measures. The first, implementing similar measures on several countries that are exporting to the US simultaneously is likely to be more efficient since it is likely to increase prices more for those who can access the market, and there may also be tougher competition in other markets as more fish are shipped there. The second, if the USA could coordinate measures with other swordfish importers such as the EU and Japan is also likely to increase the effectiveness of the measures, as it removes alternative markets for the exporting countries.

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Table 1. Descriptive Statistics

Description	Variable	Obs	Mean	Std. Dev.	Min	Max
Q_Brazil	qus1	64	206126,3	133577,4	32519	499205
Q_Chile	qus2	64	455481,9	542534	13040	2493222
Q_Mexico	qus3	64	156535,4	116934,8	11237	656783
Q_Costa Rica	qus4	64	85730,38	116808,8	0	565095
Q_Trinidad y Tobago	qus6	64	48708,5	50356,79	0	275325
Q_Uruguay	qus7	64	79517,11	86853,88	0	350603
Q_Brazil	cbr	64	1990,5	626,0342	0	2778
Catch_Chile	ccl	64	1723,5	785,4702	0	2976
Catch_Mexico	cmx	64	2098,313	662,412	0	2913
Catch_Trinidad y Tobago	ctt	64	809,25	269,7967	0	1149
Catch_Uruguay	cuy	64	1990,5	626,0342	0	2778
Catch_Costa Rica	ccr	64	2098,313	662,412	0	2913
US retail price	pretail	64	4,780052	0,6039995	3	6
w_Brazil	pus1	64	2,873542	0,365577	2,103333	3,763333
w_Chile	pus2	64	7,14974	0,9670197	4,593333	9,08
w_Mexico	pus3	64	4,62625	0,8921487	2,71	6,423333
w_Costa Rica	pus4	43	6,729147	0,7691424	5,013333	8,39
w_Trinidad y Tobago	pus6	44	7,173409	1,07324	4,69	8,913333
w_Uruguay	pus7	44	5,035644	0,837086	2,93	6,52
Wholesale price Spain	pes	55	5,876	1,171953	3,103333	8,913333
Wholesale price Japan	pjp	44	6,785227	0,8961884	5,1	9,756667
Gasoil price	gasoil	56	197,5465	62,32926	105,0433	432,4783
usd_jpy	usd_jpy	64	0,0085285	0,0010406	0,0064397	0,0118533
usd_eur	usd_eur	64	1,144491	0,1355446	0,8694413	1,385394
usd_brl	usd_brl	41	0,588357	0,2553557	0,2749697	1,037494
usd_clp	usd_clp	49	0,0019885	0,0003814	0,0013833	0,0026253
usd_mxn	usd_mxn	57	0,1276487	0,0789024	0,0003207	0,3213643
usd_crc	usd_crc	44	263,053	120,5279	0	443,61
usd_ttd	usd_ttd	44	5,361601	1,978874	0	6,2524
usd_uyu	usd_uyu	44	13,8773	8,2464	4,525933	29,72347
wage_chile	wcl	48	117,4667	9,54044	97,2	132,6667
wage_brazil	wbr	56	106,0363	6,723239	94,56667	119,9667
wage_uruguay	wuy	56	117,6065	10,70501	96,36666	127,3
wage_trinidad & tobago	wtt	40	106,1675	23,69034	45,7	137,9
wage_mexico	wmx	48	188,925	81,47162	78,7	310,3

Table 2. Parameter estimates

	Brazil	Chile	Mexico	Costa Rica	Trinidad & Tobago	Uruguay
Quantity	-0.007	0.086	0.007	0.072	0.068	0.142
	(0.12)	(4.16)**	(0.18)	(4.65)**	(1.04)	(2.32)*
Price Spain	-0.138	-0.052	0.409	0.000	-0.451	-0.013
	(1.36)	(0.55)	(5.23)**	(0.00)	(2.69)**	(0.21)
EUR	0.776	0.433	-0.244	0.367	-0.052	1.098
	(3.53)**	(1.51)	(1.63)	(3.23)**	(0.24)	(9.78)**
Price Japan	0.092	-0.557	-0.001	0.092	0.169	-0.553
	(0.47)	(3.51)**	(0.00)	(0.61)	(0.69)	(6.60)**
JPY	-0.161	0.593	0.444	-0.015	-1.012	-0.178
	(0.78)	(3.35)**	(2.61)**	(0.11)	(4.39)**	(1.34)
Gasoil	0.405	0.236	0.015	0.204	0.290	0.196
	(7.25)**	(3.83)**	-0.23	(4.31)**	(3.60)**	(4.25)**
Wages	-1.466	-0.682	0.237		0.071	-0.929
	(3.61)**	(0.95)	(2.70)**		(0.63)	(5.82)**
Catch	0.355	-0.101	-0.071	0.222	-0.211	0.358
	(2.81)**	(2.48)*	(0.98)	(2.91)**	(2.02)*	(3.38)**
Q1	0.062	0.186	0.007	0.112	0.191	0.042
	(1.38)	(2.90)**	(0.17)	(2.91)**	(2.02)*	(1.27)
Q2	0.097	-0.034	-0.029	0.156	0.213	0.047
	(2.51)*	(0.83)	(0.55)	(5.09)**	(3.58)**	(1.95)
Q3	0.007	-0.093	0.168	0.036	0.043	0.041
	(0.24)	(2.86)**	(3.35)**	(1.52)	(0.85)	(1.00)
Constant	-0.007	0.086	0.007	0.072	0.068	0.142
	(0.12)	(4.16)**	(0.18)	(4.65)**	(1.04)	(2.32)*
R^2	0.9519	0.8627	0.8766	0.7409	0.2650	0.9774
Anderson canon. Corr.†	0.0078	0.0001	0.0081	0.0000	0.4125	0.0000
Hansen J†	0.2587	0.8245	0.3948	0.1728	0.1502	0.2349
Observations	35	35	35	35	35	35

Robust z statistics in parentheses

* indicates ignificant at 5%; ** significant at 1%

† p-values

Figure 1. U.S. import prices for swordfish