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Fishy Trade:

A study on fishmeal production in Peru

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Abstract

Peru is an extraordinary rich country when it comes to natural resources because of its environmental advantages. One of the most important export products, after minerals and metal, is the product fishmeal. Fishmeal is processed fish made from fish bones and offal. Peru export this product to 85 trading partners around the world that use it to feed other animal species such as pigs, chickens and other fish.

Peru, as itself and as part of Latin America, has a long history of trade agreements. The country has, especially in these recent years, engaged in many trade agreements with partners from Asia and Europe. In my study, I have chosen to investigate whether these trade agreements have generated greater import volumes of the product fishmeal by the partner countries and thereby an increase in Peru's fishmeal exports, or if it instead generates the opposite.

In order to analyse and quantify this information, I use the method of a gravity equation with data displaying the import volume of fishmeal for each partner country. Traditional trade theory foresees that a free trade agreement is expected to generate a positive outcome on exports for the good that the country is relatively abundant in. My regression had the opposite outcome proposing that, as Peru entered the agreements they generated a negative outcome on fishmeal exports meaning that Peru's partner countries import less after the agreement had been set into force. I will discuss this outcome and analyse different reasons for the negative relationship between free trade agreements and fishmeal exports.

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1 Introduction

Free trade agreements are expected to have a positive outcome on the volume of trade and to the country's development. According to neoclassical theory of factor abundance, Peru would be expected to specialize in the production of the good which it is relatively factor abundant in (Todaro & Smith, 2015). Latin America has a long experience of free trade agreements. The first agreements ratified were more regional agreements with the neighbouring countries, which later emerged towards also negotiating with the rest of the world. The Word Trade Organization (WTO) have estimated that Latin America have signed 65 trade agreements in total by 2012. Chile and Peru has for example completed trade agreements with generally all of its trading partners (Rodriguez Mendoza, 2012) with the expectation that it will generate a positive economic boost for their economic development (Sanborn & Yong, 2013).

Peru is perhaps the most impressive case in Latin America. Peru is a country with a lot of natural resources and a good climate. The country has experienced a rapid growth due to the foreign demand for Peruvian primary products. Around 60% of the Peruvian exports are primary exports, while as the country imports industrial products (Sanborn & Yong, 2013). Trade liberalization and trade agreements may certainly generate a boost in order to increase export earnings, if the country in question have products to rely on in this export-led growth. Having a dependence on these products may generate an overdependence (Snorrason, 2012) which is an undesirable position to be placed in due to the fact that it is not sufficient in the long-run (Todaro & Smith, 2015).

Free trade are expected to have a positive effect on smaller countries (smaller countries refers to countries that are economically smaller) and the export sector is also known as more specialized and less diversified compared to larger economies (Snorrason, 2012). Peru has lately in order to take a step away from primary product exports engaged in many agreements. Both big, as the Pacific Alliance and the Trans Pacific Partnership (TPP) and also bilateral ones, such as the free trade agreement newly signed between Latin American countries and Asian countries, with the expectation of increasing the non-traditional exports and to diversify its former productive structure (Sanborn & Yong, 2013).

The rise of the fishmeal industry occurred after the world wars, as the post-war nations started to recover. Their increased demand for meat led to a high demand for protein-rich food to feed these animals (Roemer, 1970). Fishmeal is a highly protein-rich source made out of by-products from fish and offal and there are two types of fishmeal, one for direct human consumption and another for indirect human consumption (Tveteras & Asche, 2008) where I only will here focus on the latter one. Peru stands for the largest amount of fishmeal exports in the world (Fréon et al., 2013). The fishmeal industry became a way for Peru to diversify its production, experience economic growth and open up for many new industries in the country connected to the production of fishmeal. The fishmeal industry became the leading source of foreign exchange for the Peruvian economy at this time (Roemer, 1970).

Peru caught huge amounts of fish which damaged the ocean and due to the methods used in the production, it injured the marine biodiversity, the atmosphere and the health of the nearliving human population. The industry met in an early stage a reduced amount of fish in the water and even worse, to a collapse of the Peruvian anchovy fish called anchoveta. The anchoveta (which I will refer to from here on forth) is the fish almost entirely used in the fishmeal production and is according to the Food and Agriculture Organization (FAO) of the United Nation (n.d.), the most severely exploited fish in world history.

The anchoveta is a risky input source to depend on which makes it interesting to dig deeper into this industry and see in what way trade have made an effect. I think it also is highly interesting to study fishmeal production due to its adverse consequences on the environment and on both the fish- and the human population. *The aim of my study is to find out how these newly signed free trade agreements have affected the volume of imports of fishmeal by the partner countries.*

I will investigate this matter by looking at all those countries that import fishmeal, focusing on the most recent years 2005 to 2014, where 14 different agreements with Peru were set into force. I will start my thesis by explaining the advent of the fishmeal industry and what the conditions were that made its emergence possible in Peru. I will place my thesis in a context discussing different angles around my topic such as environmental issues and Peru's relation to free trade agreements. In order to execute my study I used a method very commonly used when analysing trade effects, namely, the Gravity Model. I will go through my data before I present my result, which I will thereafter analyse and end the thesis with some concluding remarks.

2 Peru & fisheries

This chapter will start out by describing the history of fishmeal trade in Peru and how it became so huge. I will continue with some externalities caused by the industry, but also by external factors such as global warming in a section focusing on environmental issues. The last section of this chapter presents Peru's recently signed free trade agreements and the different approaches these agreements have towards the product fishmeal.

2.1 The rise of the fishmeal industry in Peru

The first cannery was established already in 1930s where fishmeal and fish oil was produced as by-products from canned fish. By 1945 fish products stood for 1% of Peruvian exports which, by 1950 only had increased to approximately 3% (Tran, 2003). How Peru later years could become the largest exporter of fishmeal and fish oil in the world could, according to Roemer (1970) be explained by three reasons; discoveries, increased foreign demand and technological improvements.

The Kon-Tiki expedition[1] proved the Humboldt Currents path and so scientists further *discovered* the oceans greatness of nutrients which it contained (Roemer, 1970). The Current moves away water from the surface, offshore and brings up the deeper more nutrient rich water. This upwelling system occurring outside of Peru's coast makes it possible for the world's most productive marine ecosystem to thrive (WWF, n.d.).

When the industrialized economies recovered after the world wars, more and more people moved towards better living standards. As larger parts of their populations started to get better off, their *demand increased* for those products that before were considered luxury goods and only available to a small part of the society. The demand for more pork and poultry products increased since more now could afford it. These farm animals though needed a lot of protein-rich food which created a demand for this type of product. Peru therefore found a way to satisfy their needs, since fishmeal is a highly protein-rich source and could rapidly go from the twentieth to the first place on the scale of fishing nations. Peruvian fisheries exploited the ocean in a large scale and produced fishmeal for animal feed, in order to further export it to the demanding countries (Roemer, 1970).

[1] Thor Heyerdahl and his crew floated along the Humboldt Current on a hand-built raft in order to prove that the Polynesia was populated by people from South America and not from Southeast Asia (History, 2014).

Lobbying was exercised in the 50s in order to get support from the government towards the fish industry (Tran, 2003). As the market grew, *technologies developed* and fishing became more efficient so that small fishing boats developed into huge vessels (Roemer, 1970). There were no doubt over that Peru had in the 60s become the leading fishing nation in the world in terms of volume. Peru was now responsible for approximately 40% of the worlds' production (Iffo, 2009) and went from having 49 fishmeal processing plants in the 50s (Tran, 2003) to 154 plants in the 60s, which further stood for 18% of the total world fish catch. The production of fishmeal became the leading source of foreign exchange to the Peruvian economy with accounting for 25-30% of Peru's total export earnings (Iffo, 2009). This is a large increase since the industry in the 50s only accounted for 3% of Peru's total export earnings (Tran, 2003).

In order to get some figurative perspectives, I have in Figure 1 demonstrated the world's imports in *quantity/netweight in kilos* of Peruvian fishmeal between the years 2005 and 2013 and in Figure 2, within the same time range, demonstrates *traded value in dollar* for these imports. The first figure on netweight meets a fairly fluctuating graph with a negatively sloping trend given by the dotted trendline. The latter figure also sees a fluctuating graph but hence with the opposite outcome, having a positive trendline for the traded value in dollar.

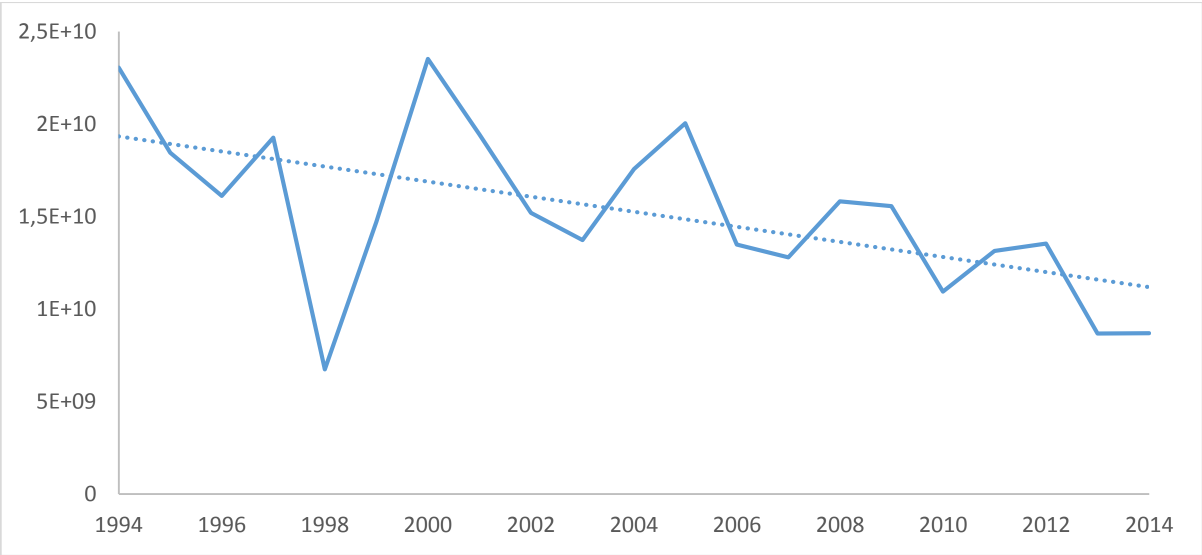

Figure 1: Netweight (kg) / Qty of the 6-digit harmonized system code 230120, imported by World from Peru. Data: UN Comtrade (2014)

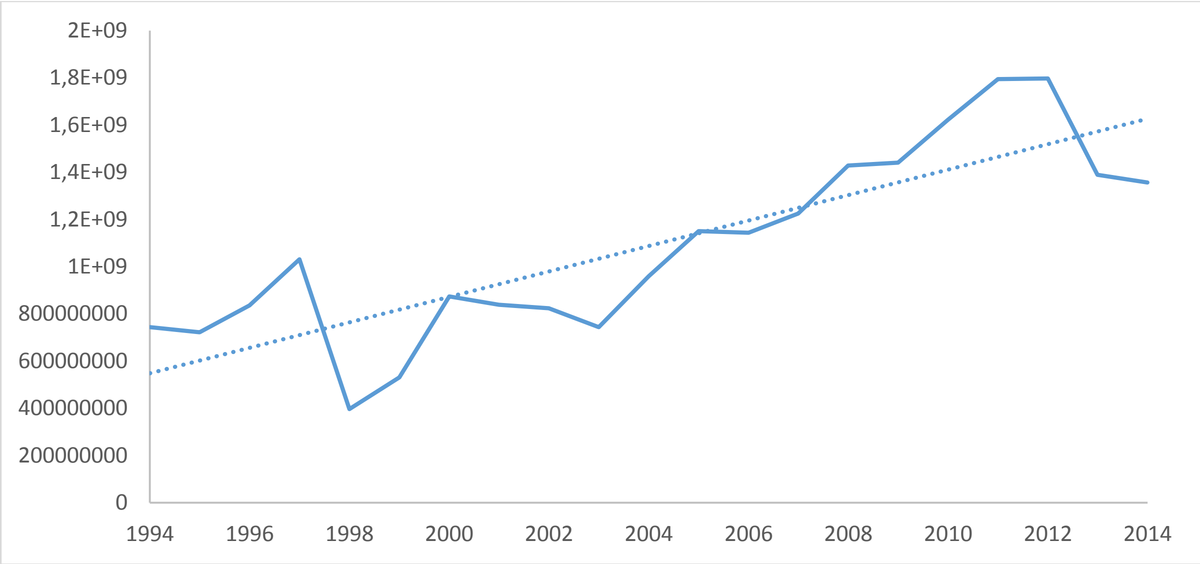

Figure 2: Traded Value $ of the 6-digit harmonized system code 230120, imports by World from Peru. Data: UN Comtrade (2014)

The type of fish mostly caught for the production in Peru was the Peruvian anchoveta. It accounted for 50% of the fishmeal production in the world in the 50s and in the 60s its importance grew to instead accounting for 99%. Companies invested in larger fishing boats in order to stay competitive which generated to that boats got a capacity of catching 16 million tons of anchoveta each year. There were, as a result, already in the mid-60s signs of overfishing in the northern and central coast of Peru (Iffo, 2009). After 1971 the anchoveta population collapsed due to both an El Nino[2] event in coexistence with overfishing (Duffy, 1983).

Not only did this effect the underwater animals, but it also had its mark on land where the Guano birds whose staple food is anchoveta, also experienced a collapse (Duffy, 1983). The production after the collapse was no longer as economically profitable as before and the Food and Agricultural Organisation of United Nations (FAO) set out warnings that in order to keep the fishing sustainable, there could not be any fishing over 9.5 million tons per year. Between the years 1970 and 1973 the annual catch went from over 12 million tons down to 1.3 million and the anchoveta population continued remaining low after that and throughout the 80s (Iffo, 2009).

[2] "El Nino is a natural disturbance of normal weather patterns and brings warm waters and heavy rain along the equator to the coast of Peru" (Iffo, 2009, p. 3)

Figure 3 demonstrates how important the anchoveta fish has been for the fishmeal industry production. The blue graph shows how the ups and downs of the annual catch of anchoveta fish globally have been between the years 1950 and 2014 while the orange graph gives the total catch of fish in Peru the same year. They are, as you may see, very similar.

Peru's fishmeal industry have been lucky in the sense that it during the fall of anchoveta fish in the 70s could temporarily rely on Sardines instead (Bakun & Weeks, 2008). This is illustrated by the orange graph not being down to the bottom between the years 1980 and 1990, as the blue graph is. The decrease still caused major damage to the production which further strengthens the fact that the industry is highly dependent on the anchoveta and has to coexist with its vulnerability.

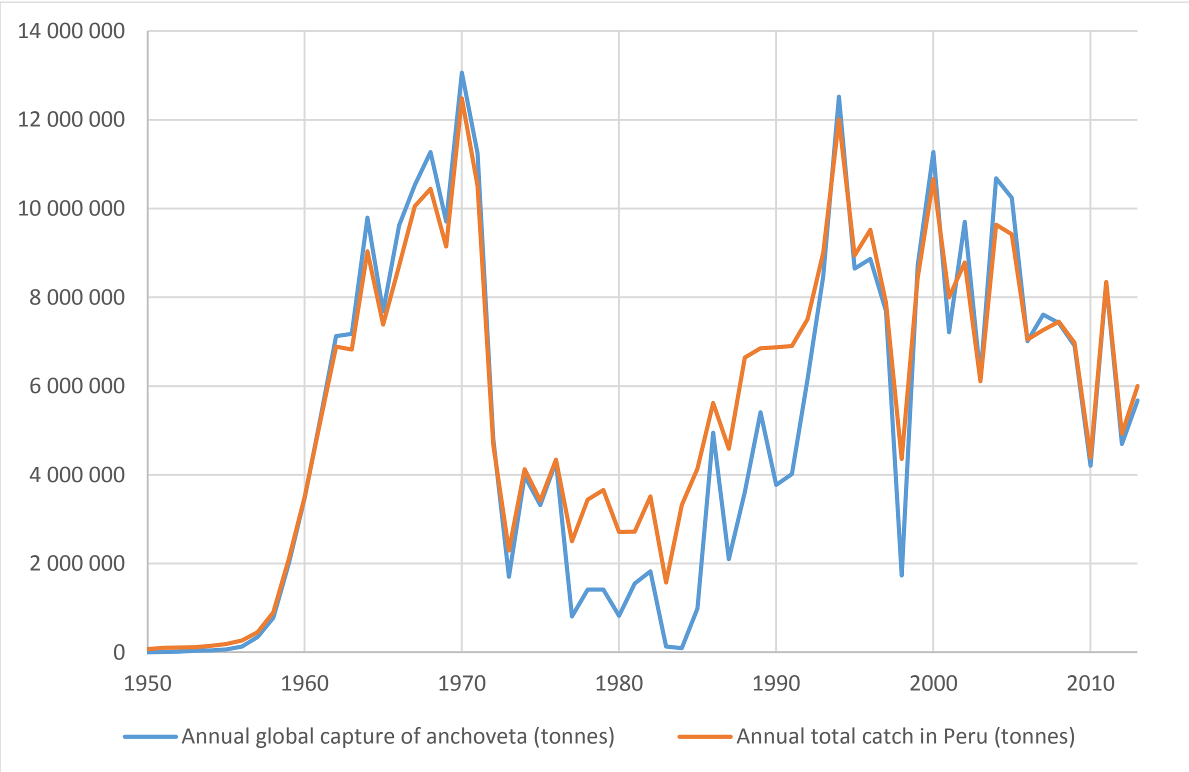

Figure 3: Annual global capture of anchoveta (tonnes) and Annual total catch of fish in Peru (tonnes). Data: Food and Agriculture Organization of the United Nations. (2016).

A development which also may have saved the industry was the rise of aquaculture farming[3]. Fishmeal was at start aimed to feed poultry and pigs or to use as fertilizers, but later years these

[3] Underwater farming of fish, molluscs, crustaceans, aquatic plants and other marine species. (NOAA, n.d.)

aquaculture farms flourished. The industry grew drastically and so did the exports of fishmeal for this purpose, to feed fish in farms. The aquaculture fish industry received 34% of the global export supply of fishmeal by the year 2002 (Tveteras & Asche, 2008) and as you can see in Figure 4 below, it has continued to develop in that direction.

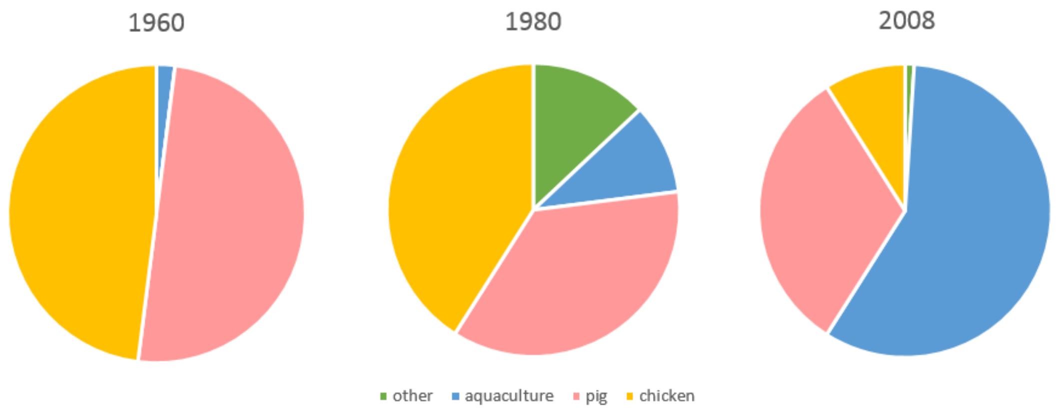

Figure 4: Fishmeal destination industries share of fishmeal export. Data: The fish site. (2012).

The fishmeal industry remained stable despite the obstacles it encountered along the way. In 2000 and 2011, the industry landed on a third place of top exporting industries, accounting for an average of 8% of foreign export earnings at this time (Avadí & Freón, 2015).

2.2 Environmental Issues

The rapid development of fishmeal industries also elicited diseconomies and less positive externalities. The guano fertilizer[4] industry got affected and declines since after the fishmeal industry found its way onto the market. The Guano birds' staple food was anchoveta, which is the same breed as the fishmeal industry relies on in its production (Roemer, 1970). Duffy (1983) discusses if there are any connections between the bird population and the commercial fishing. He argues that as the commercial fishing exerted in a large scale, there was a trend towards a lower yearly increase of the guano bird population. The Guano birds along with other piscivorous[5] declined during this period, which likely was connected to the decrease of the natural mortality within the anchoveta population (Clark, 1976).

[4] Guano is excrement (dung) of seabirds which due to the favourable upwelling system of the Humboldt Current led to the emergence of guano that is very favourable to use as fertilizers (Duffy, 1983).
[5] Animals that primarily eats fish.

The fishmeal production was, as mentioned very profitable in the beginning of its emergence which generated a rapid development of new industries in Peru. The fishmeal industries ended up having plants along the entire coastline which did not favour all parts of the economy. The city Chimbote is a famous example of when the industries along the coast stopped the attraction of the city, since it before had been a tourist destination. The contaminants in the water and in the air as well as the smell from the industries could be scented far from the city (Roemer, 1970). The way the fishmeal was produced caused major health problems for Chimbote's population. The cholera epidemic 1991-1993 which arose in Peru could for example be linked to the fishmeal industry as a result of the unhealthy pollution it leaked. The bottom trawling[6] and the heated water also caused environmental damages since the former destroyed the important seabed and the latter was poured out from the industries into the ocean which led to the emergence of dead zones[7] along the Peruvian coast (Goldmanprize, 2003).

The Peruvian anchovy experienced a collapse after 1971 as I earlier have mentioned, but an even more dramatic event took place 1982/1983 when several species disappeared. The reason was because when the overfishing continued after such strong El Nino, it created a situation where it prevented the ecosystem to resilience (Edgar et al., 2010). This is demonstrated in Figure 1 where the global capture of anchoveta is down by the bottom after this period.

In the future, greenhouse gases in the atmosphere will also affect the anchoveta fish and the volume of fishmeal production in Peru. Researchers have found that the increase of global warming will affect the upwelling ecosystem, though the theories on how the effect will be, differs. The first theory predicts that the consequence will be a declining intensity of the Pacific trade wind system, while the other predict the opposite indicating that the increase of greenhouse gases will make the upwelling system more intense. The global warming will in either way have an effect on the system and since the upwelling system is the element that enriches the Peruvian waters with essential nutrients, it will in turn effect the species survival (Bakun & Weeks. 2008).

[6] "Bottom trawling is an industrial fishing method where a large net with heavy weights is dragged across the seafloor, scooping up everything in its path." (Marine Conservation Institute, n.d.)
[7] Dead zones, in other words "hypoxia is caused by excessive nutrient pollution from human activities coupled with other factors that deplete the oxygen required to support most marine life in bottom and near-bottom water." (NOAA, 2012).

2.3 Peru's Bilateral Trade Agreements

Peruvian policy makers wanted to find ways to overcome the patterns of being dependent on primary exports. One approach was by entering trade agreements in order to diversify their production structure (Sanborn & Yong, 2013). Peru has negotiated several agreements recently and between the years 2006 and 2011, they had already both negotiated and signed nine agreements. Peru signed agreements with countries such as China, free trade agreements with the European Union and also negotiated with larger arrangements such as the Pacific Alliance and the Trans Pacific Partnership (TPP) (Rodrigues Mendoza, 2012).

There were in 2014 fourteen countries, or groups of countries, that had an agreement in force with Peru. A list of these agreements and their respectively year of entry are provided in column one and two in Table 1.

Trade Agreements	**with Peru**	**230120[8]**
Partner	**Year in force**	**Year of duty free**
Costa Rica	2013	**2013** (230120.10), **2023** (230120.90), *ten equal annual cuts.*
Japan	2012	**2012**
Panama	2012	**2027** (2301---), *Free for max. 200 metric tons per year the first 15 years.*
European Union	2012	**2012-2014**.
Mexico	2012	**2022** (230120.01), *Ten equal annual cuts starting from entry.*
South Korea	2011	**2016** (230120.10 & 230120.90) *5 equal annual stages.*
European Free Trade Association (EFTA)	2011	**2011** (230120) *Switzerland may maintain import duties.*
Thailand	2011	-
China	2010	**2015** (23012010), 1.2% 2009 then cuts 0.2% annually. **2018** (23012090), eight equal annual cuts.
Canada	2009	**2009** (230120.11, 230120.19 & 230120.90)
Singapore	2009	**2009** (230120)
Chile	2009	**2013** (230120.10), *preference margin from 0% 2008 to 100% 2013.*
US	2009	**2020** (230120), eliminated in eleven equal annual cuts.
MERCOSUR	2005	Brazil & Argentina: **2005** (230120.10) & **2008** (230120.90) *preference margin from 65% 2005 to 100% 2008.* Venezuela: -

Table 1: Data: Sice (2016).

[8] Some countries have different tariff elimination schedules to fishmeal, depending on which 8-digit harmonized system code. I chose to only look at the 6-digit, 230120, since it involves the overall fishmeal traded specifically for the purpose of feeding other animals and not for direct human consumption.

The agreements were a way for Peru to open up for new investment opportunities (Sanborn & Yong, 2013). China has played a big role when it comes to increasing the world's production of fishmeal, since Chinese consumption has been raised from 3% in 1985, to 40% of world consumption of fishmeal in 2007 (The Fish Site, 2012). Figure 5 below demonstrates the top five importing countries and 'others' (others, which refers to the rest of the importing countries of fishmeal from Peru) in terms of volume during the years 2005, 2010 and 2014.

Figure 4 showed that the aquaculture industry have been taking up the largest share of fishmeal exports latter years which has generated new trading partners, such as the one with Norway (Fréon et al., 2013). This partnership have indeed led to Norway receiving a larger part of fishmeal exports, illustrated in figure 5 below.

It appears clear that China definitely is the leading importer, approximately taking up half of the imported fishmeal each year. Peru started to move into the Asian directions when signing agreements and there are no doubt that Peru have Asia as its top destination of fishmeal exports since China, Japan and Other Asia, nes (not elsewhere specified) 2005 and Vietnam 2010 are in the top five of importers these years.

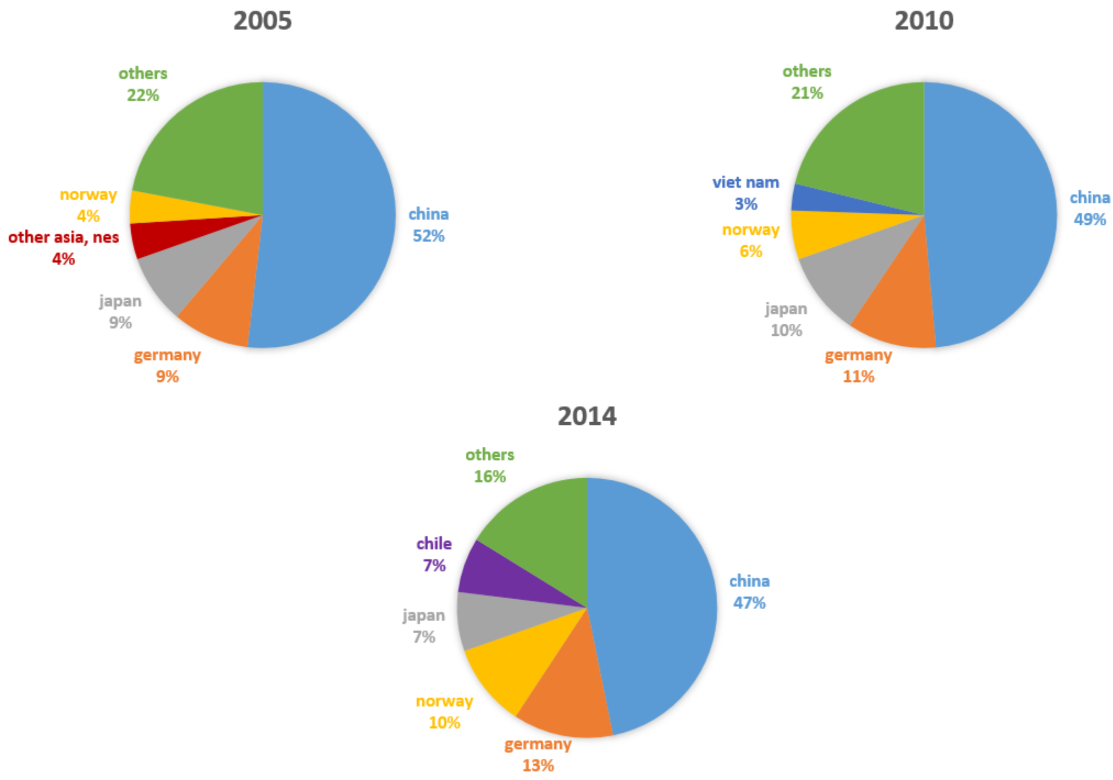

Figure 5: Top five countries (+ others) share of Fishmeal imports from Peru. Data: UN Comtrade, (2014).

Sanborn and Yong (2013) questions whether the agreements are a way to diversify Peru's production or if it rather creates a path toward an even deeper primary product export dependency. They discuss this matter laying their focus on the agreements with the Asian countries. China is a country that imports a lot of primary products from Peru, not just marine products but also and mostly, minerals and metals. Sanborn and Yong (2013) write that free trade agreements do have an important role for Peru in the sense that it has emerged new vitality and not huge, but certainly important, diversification of trade (not huge, in the sense that 95% of the exports still were traditional products).

What I further found is that the different countries' agreements have different approaches in their tariff elimination schedule toward the product fishmeal. This is described in Table 1 in the third column from the left. From this table, it is understood that Brazil, Argentina, Canada, Singapore, Norway, Switzerland, the EU, Japan, Chile and Costa Rica will have their imports of fishmeal duty free sometime between the years 2005 and 2014. The rest of the schedules though, contain different types of annual cuts toward fishmeal products and therefor will not meet a free entrance until later on after my time range (with exception for Venezuela and Thailand who does not include fishmeal in their tariff elimination schedules).

3 Assessing the effects of FTA

I will use the gravity model in order to assess the effect of Peru's free trade agreements on fishmeal exports. In this section I will first explain the basis of the gravity model and lay special weight on the procedure that is essential for my study. I will continue by explaining my data and after present it with some descriptive figures.

3.1 The Gravity model

The gravity model is a commonly used tool in order to analyse international trade. It is used to get an approximation of how large the amount of trade flows between two countries are expected to be, as well as how trade is determined by their different connections. When comparing two countries, there was found an empirical stable relationship between their sizes and the distance between them. Anderson (1979) laid forward the basic model to explain this relationship and saw pass the former Heckscher-Ohlin model where it was assumed that different countries had the same prices (WTO, 2012). Since the so called 'boarder effects' were discovered which made sure that prices differed between countries, the former Heckscher-Ohlin assumption was proved to be wrong. Anderson implemented these assumptions in the Gravity model (Reinert, n.d.) and in this model the consumers had preferences defined over all goods which were differentiated by country of origin. The model suggested that all countries consume at least some of every good from each country, no matter what the price of the product would be. In equilibrium we find the sum of home and foreign demand for the unique good that they produce, which therefore also assumes that larger countries (economically larger) import and export more than smaller countries (WTO, 2012).

The Gravity Model was further extended by authors such as Bergstrand (1985), Deardorff (1998), Eaton and Kortum (2002), Helpman, Melitz, and Rubinstein (2008) and Chaney (2008) and also Andersson and van Wincoop (2003), where the later one mentioned is the model that I will use for my estimation.

Bergstrand (1985) made empirical estimations on bilateral trade and found that there were support for the fact that goods were not perfect substitutes. His findings instead assumed that imported products were better substitutes than domestic ones. Bergstrand (1989) further provided a paper assuming product differentiation among firms rather than among countries (Deardorff, 1998), showing that the gravity model was a direct implication of a model based on monopolistic competition developed by Paul Krugman (1980) (WTO, 2012).

Deardorff (1998) did not agree with Bergstrands (1989) supportiveness of monopolistic competition, but rather noted that some forms of the Heckscher-Ohlin model and empirical evidence would together be potential evidence for some theoretical basis such as; product differentiation by country of origin, product differentiation by firm and also some particular forms of Heckscher-Ohlin-based comparative advantage (Reinert, n.d.). He therefore shows that a gravity model can explain the rise of trade by traditional factor-proportions (WTO, 2012).

Eaton and Kortums (2002) model is unlike the earlier ‘new trade theory’ competitive with neither fixed costs nor monopoly rents. Their model is like the Ricardian model but with a continuum of goods that are produced under constant-returns technology. Their contribution was the idea of a two-parameter probability model, which further created the input requirements for producing each good (Alvarez & Lucas, 2004).

Helpman et al. (2008) and Chaney (2008) further developed the model using the assumptions that some firms are more efficient than others, which in turn meant that higher productivity levels generate higher export volumes (Greenaway, Gullstrand & Kneller, 2009).

Anderson and van Wincoop (2003) who developed the basics and the model that I will use, wrote that in order to get a well-specified gravity model it was highly important to check for relative trade costs instead of absolute trade costs. They suggest that two neighbouring countries having boarders toward other large trade economies will trade less with each other than if they would have had ocean between them. These types of responses to trade are called 'multilateral trade-resistance' terms (MTR).

Anderson and van Wincoop's gravity equation takes the form:

$$X_{ij} = \frac{Y_i Y_j}{Y} \left(\frac{t_{ij}}{\Pi_i P_j} \right)^{1-\sigma} \quad (1)$$

Where X_{ij} is the monetary value of exports from i to j. Y is GDP and Y_i , Y_j denotes the GDP of country i and j respectively. t is the trade costs, where t_{ij} (meaning one plus the tariff equivalent to the overall trade cost) refers to the cost in j of importing a good from i. σ>1 is elasticity of substitution and Π_i and P_j represents exporter and importer ease of market access, or country i's outward and country j's inward multilateral resistance terms (WTO, 2012).

Estimating a non-linear model is a tricky procedure which is why, due to the models multiplicative form makes it possible to take natural logarithms of all variables. In this way, a log-linear equation is obtained. The parameters when estimated in logarithms are analysed as elasticities.

The gravity equation in trade is aimed to catch all those different variables which can affect different types of costs that may arise. In order to analyse this one can include dummy variables. Dummy variables can check if countries have common boarders; if a country is on an island or if it is landlocked; if they have colonial history; or common languages (WTO, 2012).

Further there are three issues that one may come across, which Baldwin and Taglioni (2005) call the gold-, silver- and bronze medal mistakes. The gold medal mistake leads to biased estimates and is the most serious of the classical mistakes. It appears when there is correlation between the omitted variables and the trade-cost terms. The silver medal mistake appears when taking the average of reciprocal trade flows (WTO, 2012) and the bronze medal mistake appears due to global trends and inflation rates which creates biases through spurious correlations (Cipollina & Salvatici, 2008).

The responses to trade called the multilateral resistance terms (MRT) are not always directly observed which can be solved by one widely used method; country fixed effects for importers and exporters which solves the gold medal mistake. Fixed effect investigates the relationship between the independent variable and the dependent variables within, for example, a country.

Each country then has its own individual characteristics that may have an effect on the independent variables (the political system in a country may for example have an effect on trade). Each country is different and shall therefor not have correlation between the countries error term and the independent variables (Torres-Reyna, 2007). The silver medal mistake is solved by focusing on one way trade flow at a time and the bronze medal mistake is solved by time dummies due to the fact that these global trends and inflation rates is just what the time dummy controls for (WTO, 2012).

My specification takes the form as follows:

$$\ln\left(m^{ijt}\right) = \alpha + \ln\left(mass_{ijt}\right) + \lambda_{ij} + t_t + FTA_{ijt} + \varepsilon_{ijt} \qquad (2)$$

Where m^{ijt} is the imports per country per year, α refers to the constant and $mass_{ijt}$ stands for GDP $\left(y^{it} \cdot y^{jt}\right)$ in current dollars per importing and exporting country per year where both imports and GDP are estimated in logarithms. The fixed effect is taken up by λ_{ij} variable which captures p_i and p_j which is importer and exporters ease of market access and all the unchanged bilateral trade costs. t_t and FTA_{ijt} are the time dummy and the FTA dummy, respectively. The time dummy controls for external general happenings such as business cycles, El Niños and other effects that have impact over all countries, while the FTA dummy controls when the different countries entered agreement with Peru. Lastly comes ε_{ijt} which is the error term.

3.2 Data

In this section I want to find out how the volume of fishmeal exports have been affected for the countries entering an agreement with Peru and how it has been affected for the countries that have not entered such an agreement with Peru between the years 2005 and 2014. The reason for my time range 2005-2014 is shortly because I wanted something recent and this is the most recent data that was accessible in such a comprehensive way. Peru has, during these latest years also signed many agreements which I have described earlier. This, I believe, makes it an even more interesting case to investigate.

I have collected data on imports instead of exports since there might be quantity losses during transportation which makes imports a more reliable source to use (WTO, 2012). On UN Comtrade's database I found that 85 countries had at least one time between the period 2005 and 2014 imported the 6-digit harmonized system code 230120 with the name *Flours, meals & pellets of fish/of crustaceans, molluscs/other aquatic invertebrates* from Peru. I needed to leave out one of the observed countries from my estimation, namely "New Caledonian", because the

GDP for this observation was difficult to find from a reliable source, but due to the trade volume being relatively small and the country not entering any trade agreement with Peru, it will not have a significant effect on the outcome of my regression.

Data on GDP at market prices in current dollars was found in the World Bank's Development Indicators (WDI, 2015). Here I further came across four cases where the GDP was not yet noted. This was the case for: Venezuela, New Zealand, Cuba and Faeroe Islands. Instead of leaving those out, I used the numbers from International Monetary Fund on their estimated GDP for those years that were missing. For political reasons, the United Nations is not allowed to give statistics referring to Taiwan on their database. Taiwan is an important partner due to its size of fishmeal imports and therefor did not wish to exclude this observation from my estimation. I found that Taiwan was included in Other Asia, nes (UNstats, 2010) which is why I therefore can include Other Asia, nes in my regression using Taiwan's estimated GDP found on IMFs database.

I needed to be sure that using estimated GDP for these first four countries and using Taiwan's estimated GDP for other asia, nes would not affect the outcome of my estimation so I therefore control this by estimating both with and without these countries. The outcome of this test was that the estimated GDPs had no effect on the outcome of my regression. I could therefore decide to include these countries in my estimation.

I finally, ended up having 84 countries; 10 years' time range, which gives me 9 time dummy variables (n-1); plus one dummy for FTA where 1 stands for having entered an agreement with Peru and 0 otherwise; which in total leaves me with 840 observations. In order to estimate my equation, I use the program Eviews and further on did both the theoretical part and the tests of whether to use fixed effect or not, emphasise that I should use fixed effect model.

3.2.1 FTA vs. no FTA

In order to understand the outcome of my regression properly I checked if the countries entering a free trade agreement with Peru already did normally import this good from Peru. By using normal OLS without fixed effect, I came to the conclusion that this was not the case.

I have in order to further analyse my data listed the number of agreements per year divided into two groups, 'FTA' in the blue columns and 'no FTA' in the orange columns, where the former includes the countries that enters a free trade agreement with Peru sometime between 2005 and 2014 and 'no FTA' involves those countries that do not. This is provided in Table 2 seen below. The column number four, furthest to the right, provides the total amount from the respective group and as can be seen, there are 40 countries in total that enters an agreement between the given years, and 44 countries that do not.

Countries in…	…FTA with Peru	…no FTA with Peru	
	Imports>0	Imports=0	Total
2005	33	7	40
2005	37	7	44
2006	32	8	40
2006	29	15	44
2007	35	5	40
2007	24	20	44
2008	33	7	40
2008	25	19	44
2009	29	11	40
2009	27	17	44
2010	29	11	40
2010	20	24	44
2011	29	11	40
2011	20	24	44
2012	26	14	40
2012	23	21	44
2013	21	19	40
2013	19	25	44
2014	20	20	40
2014	18	26	44

Table 2: Importing countries of Fishmeal divided in groups of entering a FTA with Peru and not, respectively. Listing trade flows as zero trade, or trade larger than zero in column 2 and 3 with the column 4 providing the total. Data: UN Comtrade (2014).

The figures 6 and 7 below are logarithmic averages of importing values each year divided into these two groups as presented above, 'FTA' and 'no FTA'. Figure 6 corresponds to both the column, 'imports>0' and 'imports=0' and therefore takes into account all observations, even those without any trade (imports=0). This then demonstrates the overall average imports of the good fishmeal between the years 2005 and 2014. The outcome in this figure gives a quite diffuse image due to the fact that so many observations are zero. Over half of the observations are for the countries not entering an agreement year 2013, 'no FTA', noted as zero trade (25 of 44) whereas 19 of the observations do import fishmeal from this group this year. These 19 observed trade flows are evened out over all 44 countries and due to this fact, will make the average into a very vague average.

It is for this reason I chose to further check if countries, when they actually do import fishmeal from Peru, imports more or less between the years 2005 and 2014. In this scenario I only include those from the column 'imports>0' in order to only focus on how the average size of the actual imports per year have developed. This is demonstrated in Figure 7 meeting a highly fluctuating graph, especially for the 'FTA' group. The 'FTA' group imports a larger amount in both cases and what can be seen in figure 7 is that this group has after 2012 started to import a much larger amount than those countries belonging to the 'no FTA' group.

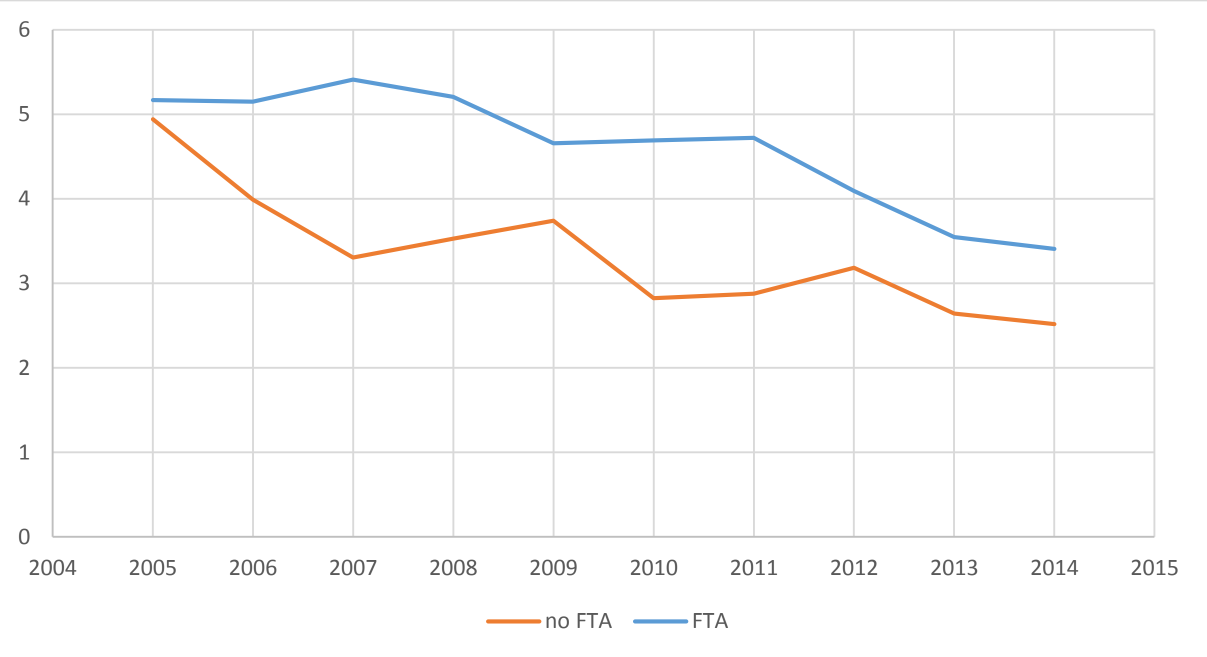

Figure 6 : Overall average volume of imports of Fishmeal by those who entered FTA with Peru and for those that did not enter FTA with Peru, respectively: UN Comtrade (2014)

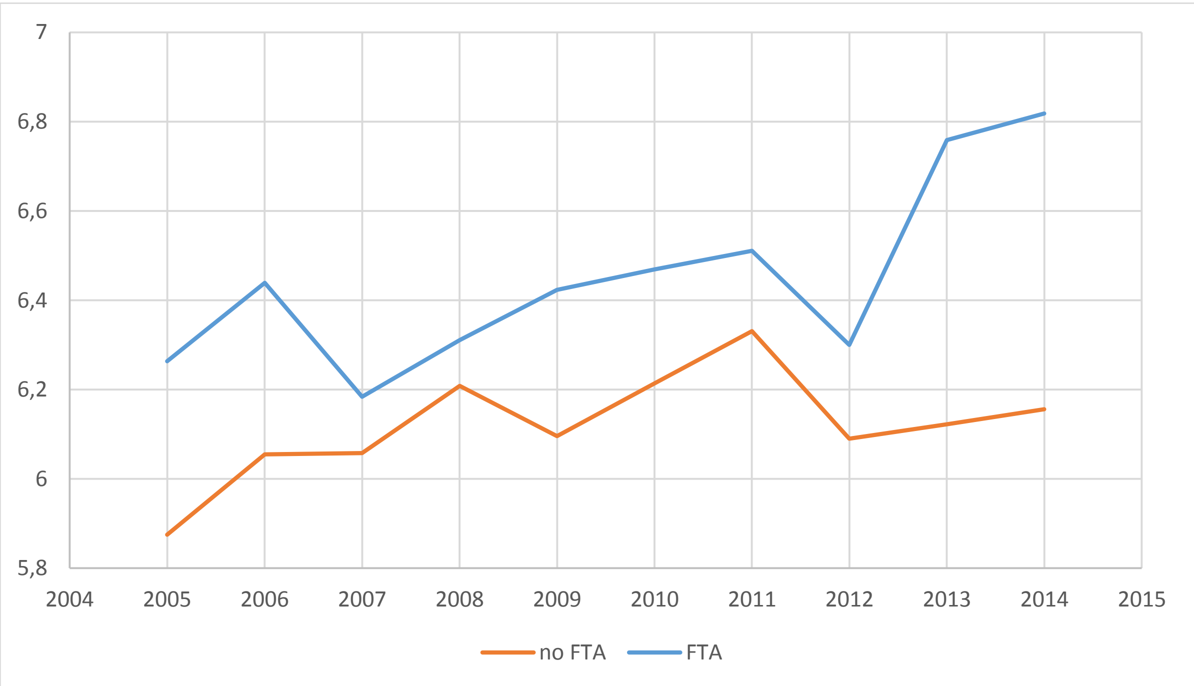

Figure 7: Average volume of imports of fishmeal where only using the observed trade (imports>0). Divided into groups of in 'FTA' or 'no FTA' with Peru, respectively. Data: UN Comtrade (2014).

4 Effects of FTA on fishmeal exports

In this section I will present my result, my major finding being the effect of FTA on fishmeal exports and after discuss what the rest of the variables indicate. I will investigate my outcome further by another regression, which will lead out to an analytical discussion about my findings.

The most important variable in my summery table is the FTA dummy (marked as blue in Table 3). The FTAs beta coefficient is negative, (-1.323870) indicating that trade decreases after a FTA have been implemented. That is, I do not find that the different FTAs increase Peru's export of fishmeal but instead rather the contrary, FTAs seem to diminish fishmeal exports.

R-square is the derivative of the explained sum of squares divided by the total variation in our explained variable. It therefore explains in how large amount our independent variables (C, LogGDP, FTA and the year dummies) can explain the dependent variable (LogImp) where 1, indicating that all can be explained and 0 meaning that it cannot explain anything. My result has an explanatory value of 0.724292 which means that my independent variables explain approximately 72% of my dependent variable.

The *coefficients* indicate how much the dependent variable changes when the independent variables increase by one unit. In my summery table all coefficients are negative except for the intercept, C. C has the round up value 37.96 which is the base level of the prediction as all other independent variables are equal to zero. The independent variable, LogGDP, is interpreted as the slope of the relation between C and the dependent variable LogImp, all else equal. In this case the coefficient is interpreted as elasticity, meaning that if GDP in the reporting country increases by one unit, it will have a negative effect on imports from Peru by 95%. Hence, here we cannot completely trust this outcome because the coefficient GDP does not have a significant effect on Imports due to its probability value being higher than 0.05.

The *F-statistic* tests how the coefficients jointly effects the dependent variable. It in other words provides the information about if the model having an explanatory power, or not. The F-statistics probability value is lower than 0.05 indicating that the coefficients in my regression jointly, together with each other, have a significant effect on Imports.

The *two-tail p-value test (*Prob.) tests the hypothesis that each coefficient is different from zero meaning that, to reject this, the p-value needs to be less than 0.05 (95%). If it is less than 0.05 we can say that the variable have a significant influence on the dependent variable. In that sense, if imports is higher than the coefficients, it is not as a significant variable to explain imports.

The beta coefficient for the dummy variables all have a significant effect on imports since their probability values are less than 0.05. I have used in my estimation robust standard errors in order to control for general heteroscedasticity problems.

My estimation did not provide the expected outcome given the theory of free trade agreements and given the former findings in Figure 7, seeing a rather positive trend. The fluctuating anchoveta population due to the strong El Niño and overfishing, should not affect the outcome of my estimation since fixed effects controls for these events affecting all countries at the same time. What may have generated the negative outcome is if Peru changed its export structure towards other products instead of fishmeal.

Cross-section fixed (dummy variables)
Using robust standard errors

Dependent Variable:	LogImp			
	Coefficient	Std. Error	T-Statistic	Prob.
C	37.96082	19.14475	1.982832	0.0478
LogGDP	-1.041007	0.758023	-1.373319	0.1701
FTA	-1.323870	0.550612	-2.404364	0.0164
2006	-1.029197	0.097137	-10.59528	0.0000
2007	-1.394856	0.226876	-6.148098	0.0000
2008	-1.202672	0.333947	-3.601387	0.0003
2009	-1.565645	0.279076	-5.610105	0.0000
2010	-2.528485	0.345259	-7.324444	0.0000
2011	-2.251544	0.435630	-5.168475	0.0000
2012	-2.129147	0.515259	-4.132190	0.0000
2013	-3.317290	0.549222	-6.029978	0.0000
2014	-3.609836	0.556504	-6.486637	0.0000
R-Squared	0.724292			
F-Statistic	20.82058			
Prob(F-Statistic)	0.000000			

Table 3: Countries and the traded values are retrieved from: UN comtrades database. The trade agreements are retrieved from: Sice (2016). Estimated data on Taiwan, New Zealand, Venezuela, Cuba and the Faeroe Islands was retrieved from IMFs database (2014). The other counties GDP was retrieved from database: World Development Indicators (2015).

My estimation did not provide the expected outcome given the theory of free trade agreements and given the former findings in Figure 7, seeing a rather positive trend. The fluctuating anchoveta population due to the strong El Niño and overfishing (Duffy, 1983), should not affect the outcome of my estimation since fixed effects controls for these events affecting all countries at the same time (WTO, 2012). What may have generated the negative outcome is if Peru changed its export structure towards other products instead of fishmeal.

4.1 The China effect

According to neoclassical theory of factor abundance, Peru would be expected to specialize in the production of the good that it is relatively factor abundant in (Todaro & Smith, 2015). Fishmeal is Peru's fifth most exported commodity and Peru stands for 50% of the global production of fishmeal (Iffo, 2009) which would in that sense be a product Peru would further specialize in. Figure 5 gives a clear image of China as being the most important partner for Peruvian fishmeal industries wince it illustrates China approximately received for 50% of the exports between 2005 and 2014. Sanborn and Yong (2008) writes that the top four products standing for 83% of total exports from Peru to China involves copper, iron, lead and fishmeal. In this sense, since my result indicates that the fishmeal exports did not increase with the free trade agreements, it may be that Peruvian exports to China contain those other products instead.

I looked further into the import structure of China to see if I would get the same outcome, a negative beta coefficient value of the agreement with China. I have in Figure 8 demonstrated Chinas top imported good from Peru in traded volume, namely, *copper ores and concentrates* with the 4-digit harmonized system code 2603 (UN Comtrade, 2014) versus fishmeal imports the same years, 2005, 2010 and 2014. Imports of copper ore has increased a lot meanwhile the imports of fishmeal, after a small increase in 2010, had by 2014 almost returned to its former value. This may strengthen the former statement suggesting that the focus on exports in the agreement with China may have been towards other products, such as copper ore, rather than fishmeal exports.

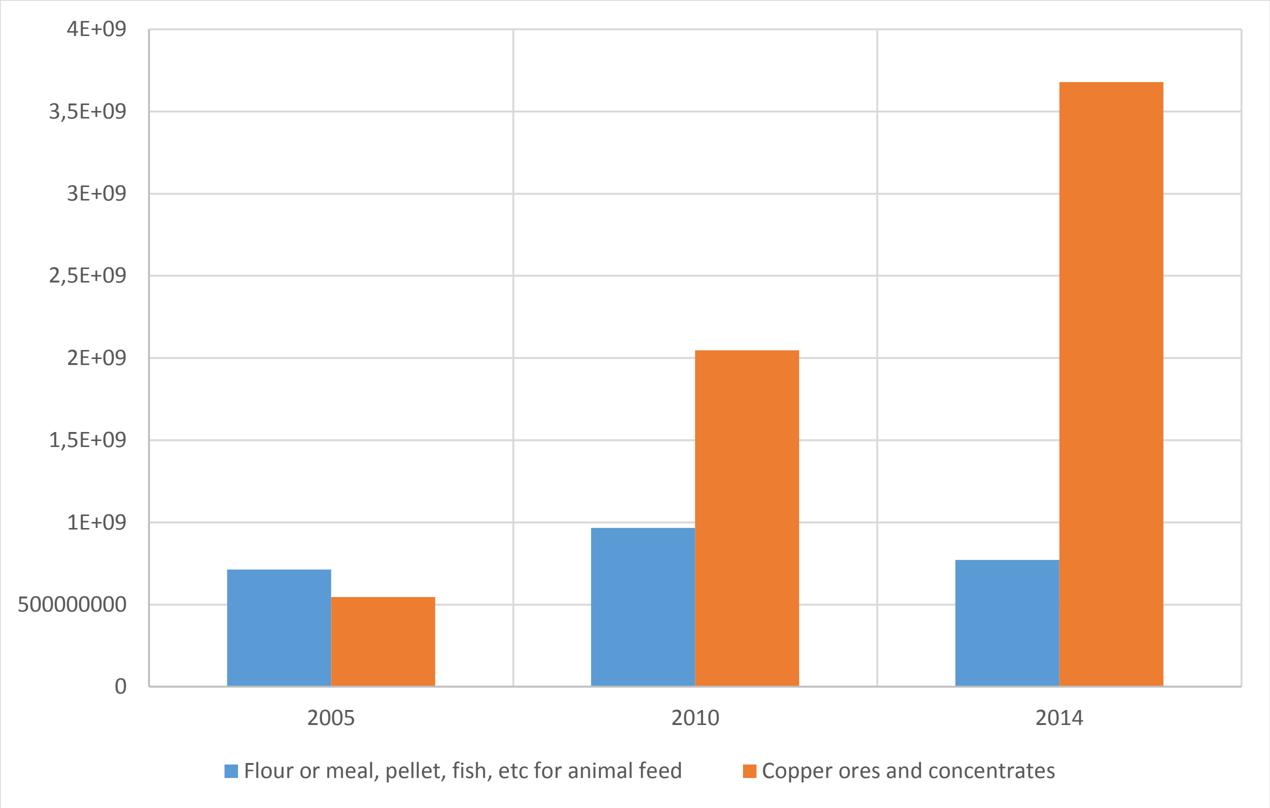

Figure 8: Comparing the development of Fishmeal imports by China, with Chinas top imported commodity, Copper ore (2014), from Peru. Data: UN Comtrade (2014).

To get a more correct analysis of this matter, I estimated the same variables estimated in equation (2), but this time including a dummy variable for the trade agreement with China by itself, $ChinaFTA_{ijt}$.

The equation now takes the form:

$$\ln(m^{ijt}) = \alpha + \ln(mass_{ijt}) + \lambda_{ij} + t_t + FTA_{ijt} + ChinaFTA_{ijt} + \varepsilon_{ijt} \qquad (3)$$

The regression outcome (Table 4) indicates that China alone, as a large importer, meets a positive and significant beta coefficient value indicating that exports with China increases after the agreement has been set into force. This speaks against the former statement that China focused on other export products rather than fishmeal, since this provides the knowledge that China did in fact increase their imports of fishmeal after the agreement was implemented. China is also included in the general FTA dummy variable, meaning that the effect is not as large as the beta coefficient for ChinaFTA indicates. Hence, it is still relatively large and positive compared to the FTA beta coefficient.

The R-Square, providing the information on how much of the independent variables are explaining the dependent variable, has not changed much from equation (2), meaning that this do not give a better nor a worse explanation of the dependent variable, namely, LogImp.

Cross-section fixed (dummy variables)
Using robust standard errors

Dependent Variable:	LogImp			
	Coefficient	Std. Error	T-Statistic	Prob.
C	54.84211	19.58871	2.799679	0.0052
LogGDP	-1.709060	0.775509	-2.203791	0.0278
FTA	-1.619830	0.550561	-2.942145	0.0034
ChinaFTA	4.906437	0.764098	6.421212	0.0000
2006	-0.943589	0.099378	-9.494940	0.0000
2007	-1.194908	0.232110	-5.148033	0.0000
2008	-0.908361	0.341650	-2.658745	0.0080
2009	-1.308959	0.288508	-4.536992	0.0000
2010	-2.269253	0.350729	-6.470102	0.0000
2011	-1.902956	0.446009	-4.266631	0.0000
2012	-1.677053	0.541351	-3.097904	0.0020
2013	-2.831650	0.577044	-4.907166	0.0000
2014	-3.117063	0.584622	-5.331760	0.0000
R-Squared	0.725454			
F-Statistic	20.69401			
Prob(F-Statistic)	0.000000			

Table 4: Countries and the traded values are retrieved from: UN comtrades database. The trade agreements are retrieved from: Sice (2016). Estimated data on Taiwan, New Zealand, Venezuela, Cuba and the Faeroe Islands was retrieved from IMFs database (2014). The other counties GDP was retrieved from database: World Development Indicators (2015).

Now having the information on both the FTA effect and the China effect verifies that fishmeal did favour large importers after entering an agreement with Peru. This corresponds to the graphs in Figure 7 demonstrating a larger gap between the 'FTA' group and the 'no FTA group', where the former increases dramatically, leaving the latter group on a remaining low level, indicating that exports to the FTA partners increased a lot in volume, in comparison.

The fishmeal productions restricted output due to its vulnerable and highly fluctuating input source, the anchoveta, may have caused the result to become negative. It seems like trade agreements have made it easier for each individual partner to access fishmeal in a larger scale over time, meanwhile trade sees a rather stagnating trend for those outside such agreement. The exports of fishmeal, may therefore later years have been more concentrated on fewer export partners, which may further explain the outcome in Figure 7. The annual cuts implemented in several of the important partners' tariff elimination schedules (such as China) should generate that fishmeal meets lower import duties each year, becoming more accessible for these countries markets. Given in figure 5, is a decreasing percentage of fishmeal export going to 'others', while the parts going to the top five importing countries becomes larger each year, which further strengthens the former statement.

5 Concluding remarks

I will start by summing up the major finding of my study, then continue to speculate around the result and end by announcing some interesting research topics.

The aim of my study was to dig deeper into Peru's recently signed free trade agreements to see what affects they had on Peru's exports of fishmeal products. When estimated, using the Gravity Model with fixed effects, I got a result indicating that free trade agreements did not have a positive outcome on fishmeal exports but instead received the opposite result indicating that the agreements had a negative effect on fishmeal exports. This further led to a continuing analysis focusing on the most important partner of receiving fishmeal exports, namely China. The second estimation provided a positive outcome meaning that the agreement generated larger exports to China. From the theoretical and from my quantitative findings, it seems so that fishmeal exports have become more concentrated among those countries that procure larger volumes of fishmeal exports, instead of for all the trading partners.

Peru's fishmeal industry hardly existed in the 50s and by the 60s, the foreign demand for protein rich food for feed increased (Iffo, 2009). Peru satisfied this demand and started to develop fishmeal industries along the coast, a specialization of a product that Peru was relatively abundant in. This specialization in fishmeal caused the emergence of other industries as well which made it possible for this production to grow in such fast pace. The constructions of boats, production of nets, as well as other manufactures also grew besides the fishmeal industry (Roemer, 1970). So, I speculate that if investigating the effect of trade on Peru's growth due to the fishmeal industry at this time, there would have instead been a positive trend.

This speculation do not go along with today's outcome, given by my findings, which is due to different factors such as global warming (Bakun & Weeks, 2008), the exhaustion of the fish in the ocean, the way the industry affected the surrounding environment by pollutants, strong El Niño events and other such events which prevented the fishmeal industry to continue growing in its former speed (Edgar et al., 2010). It seems, in Figure 7, that the fishing in general in Peru moves towards a more stable amount which may be due to the warnings laid out by FAO and other similar measurements to preserve the anchoveta fish, pressuring the fisheries not to catch in the former destructive way (Iffo, 2009). The industry have generated a boost the economy, but it is not large enough to rely on for a long term economic growth (Roemer, 1970).

The reason for the FTA effect taking a negative beta coefficient value, while FTAChina a positive value, may be due to the fact that the first mentioned takes into account all those countries that ever imported fishmeal from Peru between the years 2005 and 2014. Even though a country imported a very small volume of fishmeal only at one year they still are included for every year in my estimation. This can give a vaguer image of the actual trade, since it evens out the traded volumes of those countries that do import more. The estimation would perhaps generate a more precise outcome if only focusing on trade with countries that meets some restrictions, such as; countries that traded at least an amount larger than zero every year between 2005 and 2014; countries that traded at least above X volume/quantity at least one year between 2005 and 2014. Then it rather focuses on Peru's important fishmeal partners and leaves those other observations, making the estimation more diffuse, out.

Many of the agreements newly signed, as provided in Table 1, also includes annual tariff cuts instead of the fishmeal meeting a direct duty free entrance. This may affect the outcome of my regression, meaning that the effects of the trade agreements may not have generated a noticeable effect yet for most of the agreements, which can further be another reason for the FTA dummy becoming negative.

5.1 Further research

Due to the agreements being so recently signed, it would be interesting to see how the trend, estimating in the exact same way, has developed after a 10 years' time from today. It would then be possible to follow the effects of the tariff cuts over time, in order to see if fishmeal exports were focused more among few larger economies, or if the destinations were spread out instead.

It would also be interesting to do further research on fish for human consumption and fish for indirect human consumption, and compare the 'losses', or correspondingly the 'gains', from food it would generate to skip the first chain of feeding animals first (producing for indirect human consumption). Gains, in the sense of both environmental (since it takes a lot more quantities to produce for feeding animals first and then feed humans with the farmed animals than for direct human consumption) and in the sense of human gains in terms of reducing hunger (poorer countries has a scarcity of protein rich food).

The overfishing and pollutants was an indirect consequence of a high foreign demand (Roemer, 1970). This type of negative externalities from major extracting to meet high demands are also seen in the demand for, for example some minerals and oil (Li, 2007). So, if there were no such high demand for these products, then the extraction for minerals and the overfishing would not take place in such a large extent. I therefore further wonder, if those demands could be raised they it should also be possible to lower them. It would be interesting to investigate if there are ways to lead demands towards more sustainable alternatives.

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Picture

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Appendix

Countries	FTA[9]		
Argentina	1	Italy	1
Armenia	0	Jamaica	0
Australia	0	Japan	1
Austria	1	Jordan	0
Belarus	0	Kuwait	0
Belgium	1	Latvia	1
Belize	0	Lebanon	0
Bolivia (Plurinational State of)	0	Lithuania	1
Bosnia Herzegovina	0	Malaysia	0
Brazil	1	Mauritius	0
Bulgaria	1	Mexico	1
Cote d'ivoire	0	Montenegro	0
Cambodia	0	Netherlands	1
Canada	1	New Zealand	0
Chile	1	Nicaragua	0
China	1	Norway	1
China, Hong Kong SAR	0	Other Asia, nes	0
Colombia	0	Panama	1
Costa Rica	1	Philippines	0
Croatia	1	Poland	1
Cuba	0	Portugal	1
Cyprus	1	Rep. of Korea	1
Czech Rep.	1	Rep. of Moldova	0
Denmark	1	Romania	1
Dominican Rep.	0	Russian Federation	0
Ecuador	0	Saudi Arabia	0
Egypt	0	Serbia	0
El Salvador	0	Singapore	1
Estonia	1	Slovakia	1
Faeroe Isds	0	Slovenia	1
Finland	1	Spain	1
France	1	Sri Lanka	0
Germany	1	Switzerland	1
Ghana	0	TFYR of Macedonia	0
Greece	1	Thailand	1
Guatemala	0	Turkey	0
Honduras	0	Ukraine	0
India	0	United Arab Emirates	0
Indonesia	0	United Kingdom	1
Iran	0	USA	1
Ireland	1	Venezuela	1
Israel	0	Viet Nam	0
Countries:	**84**	**FTA:**	**40**

[9] All of Peru's FTAs that are set into force between the years 2005 and 2014.