

WORKING PAPER SERIES

No. 5/2016



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Prosjekt 233840

Competition, cluster and market analyses for salted and dried cod industry

Finansiert av Norges Forskningsråd

Abstract

The objective of this study is to examine the Brazilian market in salted & dried cod, by presenting an analysis of the demand for this product from 1989 to 2014. Norway is the leading exporter of salted & dried cod to Brazil, followed by Portugal. China recently gained presence in the market, but is still only of moderate importance in terms of export volume. Although cod forms part of the daily diet of many Brazilians, it is worth considering seasonal demands, with high import volumes around Easter and Christmas. Through an estimation of the demand function, our findings are aligned with economic theory. An increase of 1% in the price of salted & dried cod leads to a reduction in import quantities of 0.66%, i.e., demand is considered inelastic in relation to the price, and an increase of 1% in the exchange rate, i.e., an exchange devaluation, negatively affects the consumption of cod by 0.98%. Furthermore, a 1% increase in family income was found to positively affect cod consumption by 1.3%. The result reveals a significant elasticity of income-consumption, indicating that changes in household wages imply significant changes in the consumption of salted & dried cod – a fact that has implications both for the volume of Brazilian imports as well as for the fishing economy as a whole.

Keywords: Cod, OLS, Demand, Brazil.

0. INTRODUCTION

Salted & dried cod is one of the main seafood products imported to Brazil. Traditionally, this product is consumed mainly by high-income households at Easter and Christmas (Camargo Neto, 2014). All the supply of salted & dried cod comes from imports, mainly from Norway and Portugal. Therefore, the consumption is influenced by the exchange rate variation and the availability of the product in the country of origin. According to Bjørndal (2011), the main international market for salted & dried cod is Portugal, followed by Brazil.

Cod is a cold-water fish not found in Brazilian waters, but the fish stocks are exploited by several countries including Norway, which is an important country in this fishery (Bjørndal and Lindroos, 2013). Portugal and Norway are important in cod processing while Brazil has been a destination for salted & dried cod for decades (Camargo Neto and Abdallah, 2014). However, in the last couple of decades, the Brazilian market has shown demand for a greater diversity in the way in which cod is processed.

Salted & dried cod is considered expensive compared to other protein sources available in the domestic market. The product has not only an added value due to being processed, but also because it is a scarce natural marine resource. During the late 1990s, the fishing states involved in cod capture fisheries started to manage the stocks to avoid overexploitation (Lopane, 2014). This involved the introduction of quotas and restrictions to reduce fishing, particularly in Europe; while in Canada Atlantic coast cod fishing was banned as the stock was severely overexploited. This period coincides with Norway and Portugal becoming the major exporters to Brazil.

Few studies deal with fishery economics in Brazil (e.g., Abdallah and Sumaila, 2007; Vicente *et al.* 2014; Fagundes *et al.*, 2002; Abdallah, 1999), even given its position as one of the biggest consumers of salted & dried cod (Bjørndal, 2011). Most studies focus on the international market (Bjørndal and Lindroos, 2013; Asche *et al.* 1998, Asche *et al.* 2002, Asche *et al.* 2004, Ferreira Dias *et al.* 2002, Nielsen 2005, Gordon and Hannesson, 1996; Bose and McIlgrom, 1996).

Given the importance of salted & dried cod not only in the Brazilian market, but also in the international market, a demand analysis for this product was conducted. The study focused on the import demand for salted & dried cod from 1989 to 2014, identifying and quantifying the main variables influencing this demand.

This paper is organised as follows. In section 1, we provide an overview of the Brazilian market development for salted & dried cod and present the data used for estimation.

In section 2, the methodology is presented and empirical results given. The final section discusses the results and further research. The Appendix gives additional data.

1. EVOLUTION OF SALTED & DRIED COD CONSUMPTION IN BRAZIL

Cod is one of the main fish products imported by Brazil. There are several types of imported cod products, with salted & dried cod being the most common, followed by dried cod, salted cod and less often, smoked cod. Traditionally, salted & dried cod is consumed by high-income groups in Brazil, due to its high price. From 1989 to 2015 (Oct), annual imports were on average 9,360 tonnes (Brazil, 2015).

According to the Brazilian household surveys from 1987, 1995, 2002 and 2008 (Figure 1), the southeast region presented the highest consumption expenditure per capita for *bacalhau* (salted & dried cod). The states of São Paulo and Rio de Janeiro are also the main importers of salted & dried cod (>50% of imports; Aliceweb, 2016). However, part of the imports is redistributed to other states, given the importance of the ports in these regions (Barroso and Wiefels, 2010; Neiva *et al.*, 2010). Since 1994, salted & dried cod has been exempt from import tax (Ordinance 1335/94).

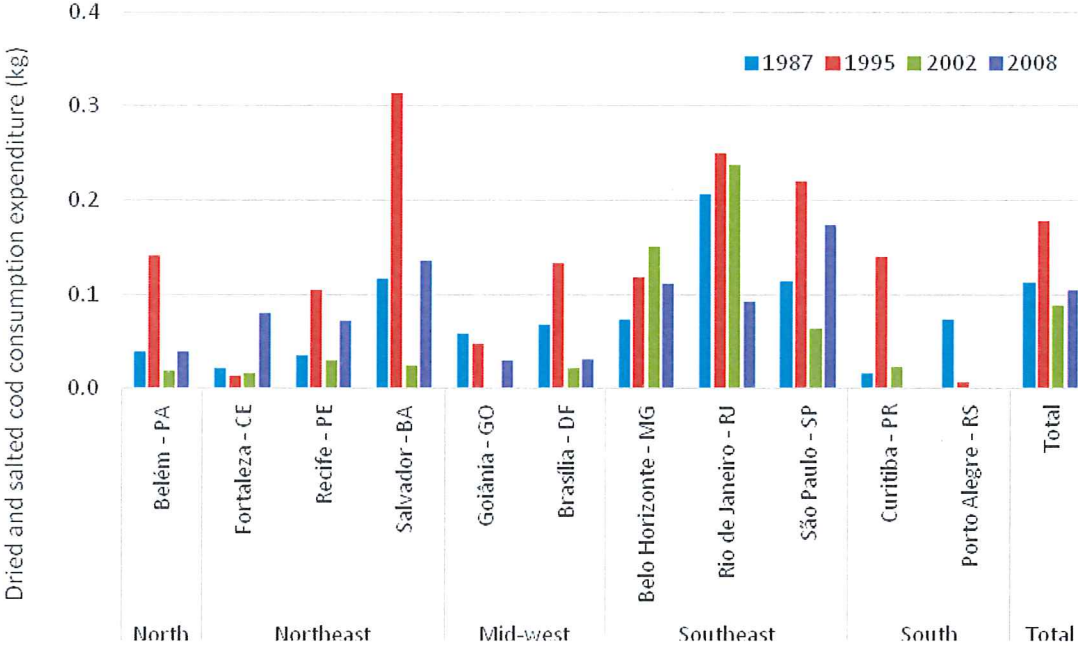


Figure 1. Dried and salted cod consumption expenditure (kg/per capita) by region and total average, for 1987, 1995, 2002 and 2008.

Source: Brazilian household survey. Brazil (2016).

According to the Norwegian Seafood Council (*apud* Lopane, 2014) Brazil started importing dried & salted cod in 1843 when it was introduced to Brazil by the Portuguese royalty. From 1808 up to the Second World War, bacalhau was considered a cheap product. However, consumption then shifted to higher income groups and was restricted to religious periods such as Christmas and Easter. This was mainly due to the scarcity of bacalhau leading to its price increase (Lopane, 2014).

In recent decades, bacalhau has become more popular again, with different qualities and products available. According to Brazilian law, only two species are considered bacalhau - *Gadus mohua* (Atlantic cod) and *Gadus macrocephalus* (Pacific cod). Other species must be called “tipo” bacalhau (cod-like fish) as these are usually of inferior quality, such as Alaska pollock. The highest quality is called “imperial”, followed by “universal” and “popular”. There are mainly three different products: dried & salted cod (most Atlantic cod, Pacific cod, saithe, ling and zarbo), frozen desalted salted & dried cod (most Atlantic and Pacific cod) and shredded cod (most Alaska pollock and saithe) (Lopane, 2014).

During the last two decades, Brazilian consumers’ purchasing power has increased (with the exception of the last few years, due to the economic crisis which has befallen the country), and this has changed food consumption habits to favour more processed food (ready meals) (Lopane, 2014). In this regard, the frozen desalted salted & dried cod meets this new consumption pattern. Brazilians are also eating out more, and bacalhau is on the menu in many restaurants and bars (POF, 2016; Lopane, 2014).

Brazil is the second biggest market for Norwegian salted & dried fish, in both quantity and value. Norwegian companies export salted & dried fish made of cod, saithe, ling and cusk. Salted & dried cod has been the largest product in terms of value, while exports of salted & dried saithe has historically been the largest product in terms of quantity.

Consumer surveys show that taste, tradition and concerns about health are the main reasons that Brazilian consumers choose salted & dried fish. The most important considerations for Brazilian consumers when buying this product are the (low) price, colour (which should be light) and the thickness of the fish. Most consumers buy salted & dried fish in supermarkets or local markets (Lopane, 2014).

Mislabelling of the different species used in various products has been a challenge, particularly in the labelling of shredded salted & dried fish. In the southeast region (Rio de Janeiro and São Paulo) this has improved, but in other regions it is still a problem (Egeness *et al.*, 2015).

The number of new, more convenient, affordable products that are easier and faster to prepare, has expanded in the market, such as the frozen desalted dried & salted cod. This is an answer for the high cost and the long cooking time related to the salted & dried fish in Brazil. This quantity of this product available has increased from almost zero to 7,500 t in five years with Portugal the main producer. Cod products are probably responsible for more than 90 percent of this category in terms of quantity, while the remaining 10 percent is salted & dried saithe. Loins dominate this category, but there are also tail and shredded fish. A large proportion of the production of frozen desalted dried & salted products come from Norwegian salted & dried fish, so the increase in demand for this product has created a new market for Norwegian salted & dried fish producers. At least one Norwegian company is currently involved in the production of this frozen product in China (Egeness *et al.*, 2015).

Salted and shredded Alaska pollock produced in China is the biggest competitor to salted & dried saithe (Egeness *et al.*, 2015). The low cost, lighter colour and convenience are the main reasons why these products are expanding in the market. For example, pollock requires a shorter rehydration time than salted & dried saithe because the pieces are smaller making it an ideal ingredient in salads, casseroles or salted & dried fish bowls.

Exports of salted & dried saithe to Brazil from Norway has declined in recent years. Lower quotas and reduced landings of saithe explain some of this change. Competition from lower priced salted Alaska pollock and cod may also explain the reduced demand.

More supermarket chains offer pre-sliced and packaged products of fully salted & dried cod. Market surveys show that it is primarily Portuguese and Chinese suppliers offering such products but some supermarkets also prepare such products. Some Portuguese companies are specialised in supplying chopped products that are faster to pack in store than traditional whole dried & salted cod. Norwegian companies have no such products in their portfolios and this may provide another explanation of why the demand for Norwegian salted & dried cod has not grown as quickly as expected. Apparently, the Portuguese are increasing their market share for whole salted & dried cod, which may be partly due to them offering packaged products (Egeness *et al.*, 2015; see also Bjørndal *et al.*, 2016a and b).

Exports of ling and cusk are becoming marginal products in Brazil (Egeness *et al.*, 2015). In 2014 there was a decline in exports of cusk and an increase in exports of ling. A large proportion of this change can probably be attributed to changes in the availability of raw material. The volume of exports of ling can be explained by a lower export price. There is little difference between the prices of dried and salted saithe, ling and cusk.

The main factors that explain the changes in the market in Brazil are higher purchasing power among the population, increased competition, investment in advertising and other marketing initiatives, more demand for product development, larger retail chains having a greater share of the grocery retail market, a greater proportion of "modern supermarkets" including grocery stores, a larger share of the seafood sold in the retail chains, increased demands for economic optimization of the distribution from the wholesale function to store shelves and a higher number of value added products on the market (Egeness *et al.*, 2015).

The main exporters of cod to Brazil are Norway, Portugal and China (Brazil, 2015), the latter being a recent exporter of this product to Brazil. Figure 1 shows the development in the Brazilian imports of salted & dried cod from these three main exporters, together accounting for more than 90% of imports¹. In the first two years of the data series, Norway was the only supplier. Portugal entered the market in 1991, initially with very small quantities, but increasing its share from 10% in 2000 to 40-41% in 2013-14. China entered the market in 2008 and reached a market share of 7% in 2013, which went down to 6% in 2014. Thus, Norway has been losing its share over time from 100% in 1989-90 to just over 50% in 2014. These developments may be related to the opening of the Brazilian market and the shift to a floating exchange rate in this period.

Norwegian exports increased from 6,000 tonnes in 1989 to 17,000 tonnes in 1998, but subsequently dropped to 4,000 in 2002. After that, Norwegian exports increased to approximately 7,000 tonnes in 2014. The reason for the development in imports between 1992 and 1998 may be related to Brazil's economic stabilisation, the increase in purchasing power and the favourable exchange rate as will be discussed further below.

¹ In addition, small quantities come from countries such as Iceland, Spain, the United Kingdom and the United States.

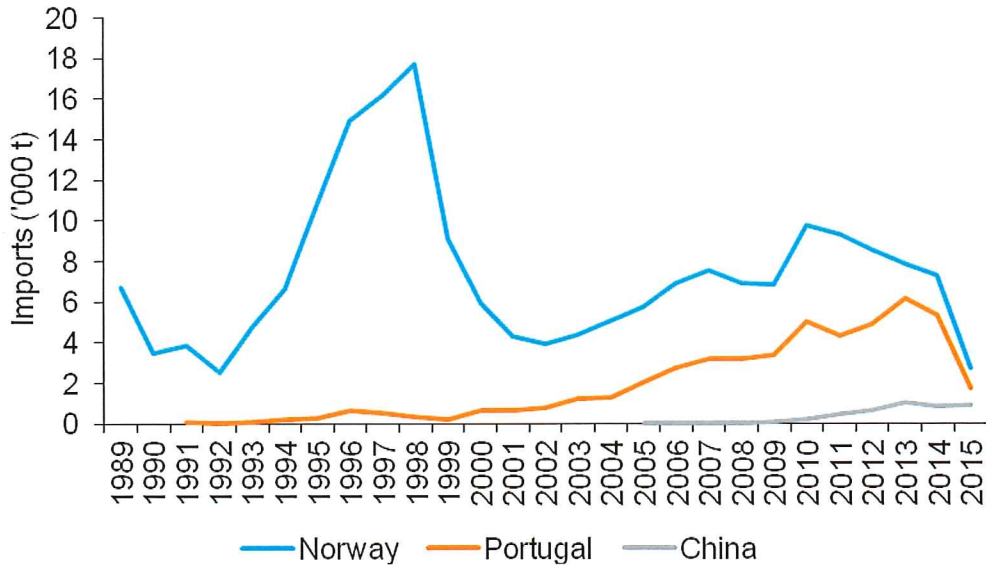


Figure 1. Brazilian imports of salted and dried cod from Norway, Portugal and China, from 1989 to 2015 (Oct).
Source: MDIC (2015).

Figure 2 presents the import prices (FOB USD) of salted & dried cod from Norway (from 1989 onwards), Portugal (from 1991 onwards) and China (from 20xx onwards). During this period, Norwegian prices were higher than those for the Portuguese product, except for the period between 1997 and 1999. The annual average import price for salted & dried cod from Norway and Portugal was \$8.00 and \$7.50 per kilogram, respectively, for the whole period studied. After 2002, when the imports by volume began increasing again, the import prices from Norway and Portugal also increased, amounting to \$8.60 and \$8.00 per kg, respectively. Since 2008, both Norwegian and Portuguese prices have been competing with Chinese prices, which are usually lower by, on average \$5.60 per kg, except in 2008, amounting to \$12.21 per kg.

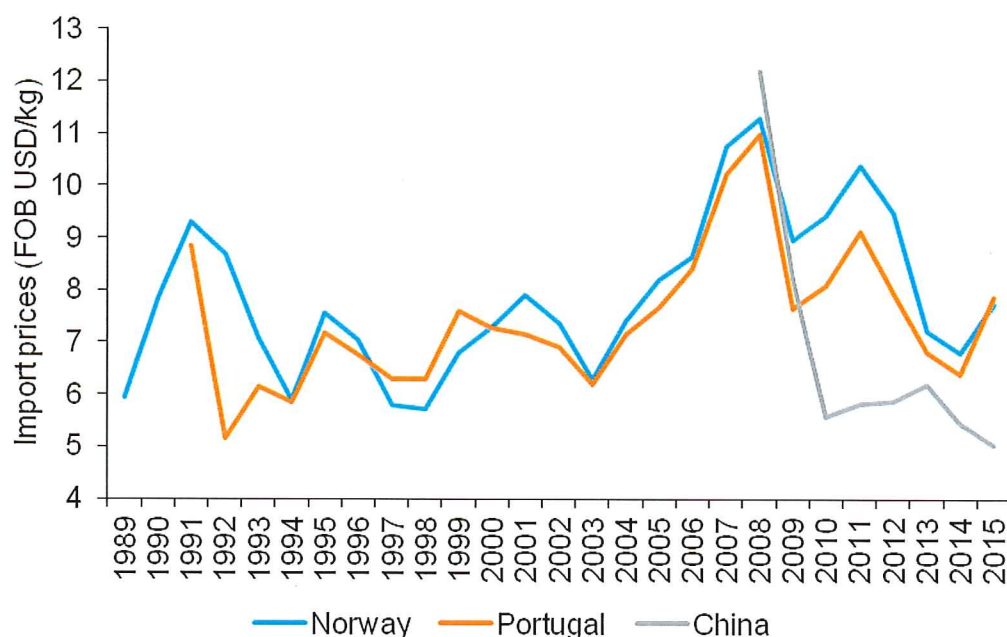


Figure 2. Brazilian import prices of salted and dried cod from Norway, Portugal and China, from 1989 to 2015 (Oct).
Source: Brazil (2015).

Figure 3 gives the real, effective exchange rate from 1989 to the present. Up to 1994 Brazil had a floating exchange rate. In the second quarter of 1994 a fixed exchange rate was introduced which was in effect until the end of 1998. From 1999 onwards, the exchange rate was again floating.

The policy of a fixed exchange rate regime had significant impact on cod consumption, since this reduced the price for cod by fixing the exchange rate of 1 R\$ = 1 USD (nominal exchange rate). At the time, the country experienced low inflation and high purchasing power, which led to a high consumption of cod (see Figure 1). In 1999, the floating exchange rate meant that there was a decrease in the consumption of cod due to the devaluation of the Brazilian currency. Consequently, cod became more expensive in the domestic market. A real valuation trend in the Brazilian currency started in 2002, which contributed to an increase in cod consumption (see Figure 1).

The years with high import volumes were also the years with a fixed exchange rate in the country (1 USD = 1 BR). This stimulated the consumption of salted & dried cod, as it made the product relatively cheaper for Brazilian consumers. However, in the following years when the exchange rate was allowed to vary, there was a reduction in consumption because there was devaluation in the Brazilian currency. The opposite occurred during periods when the Brazilian currency was revalued. In recent years, there has been a reduction in import volume, which might be explained by the unfavourable exchange rate. However, the imported

volume is still higher than the annual average over the period as a whole (9,360 tonnes); in 2014, the Brazilian imports of salted and dried cod amounted to 12,610 tonnes.

Currently, Brazil is going through an economic crisis, which resulted in a devaluation of the currency, as shown by a devaluation of the exchange rate from 2010. This increases the price of cod in the domestic market and consequently, decreases consumption.

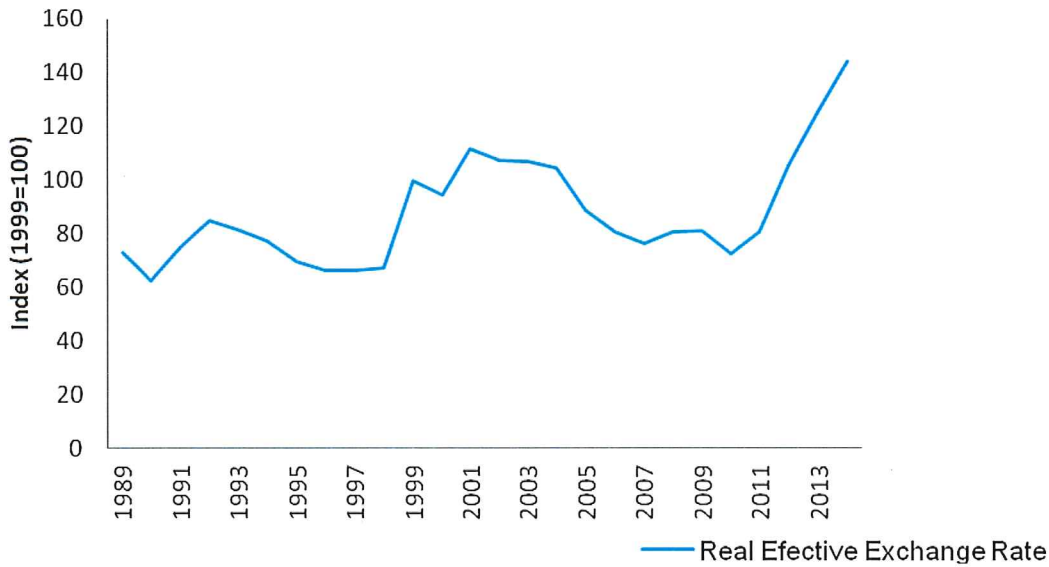


Figure 3 - Real effective exchange rate.
Source: Appendix, Table A1.

It is expected that levels of cod consumption will depend on income. As can be seen in Figure 4, average income increased towards the end of the 1990s. This was a period of stabilized inflation in the country, contributing to an increase in cod consumption, as shown by Camargo Neto & Abdallah (2014).

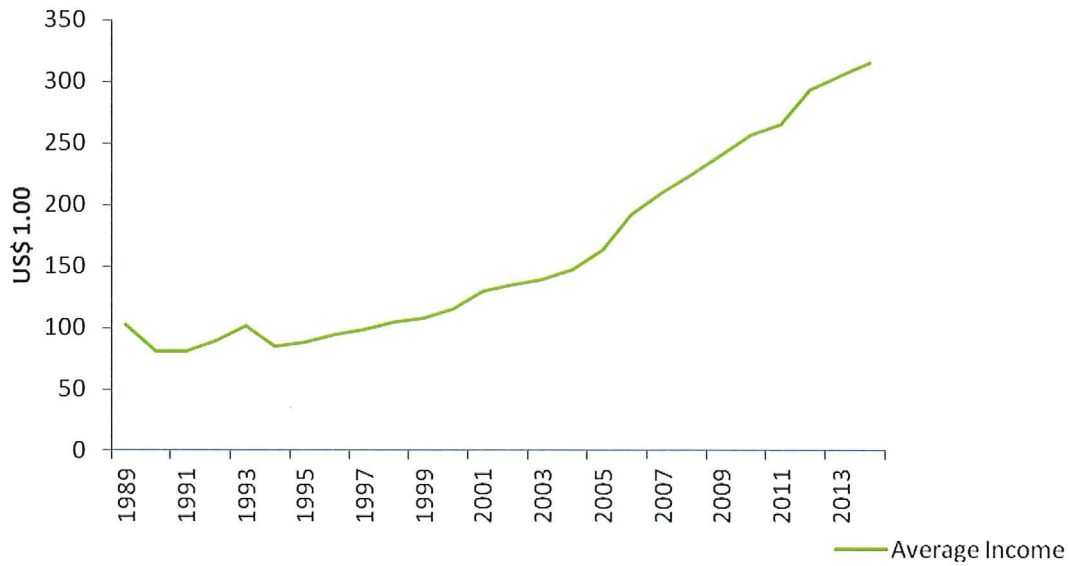


Figure 4 - Average income (minimum wage - purchasing power parity).
 Source: Appendix, Table A1.

Traditionally, salted & dried cod is consumed at Easter and Christmas, as illustrated in Figure 5. However, according to Lopane (2014), the consumption of salted & dried cod on an everyday basis has been increasing, partly due to its availability in restaurants and the increasing trend for consumers to dine out.

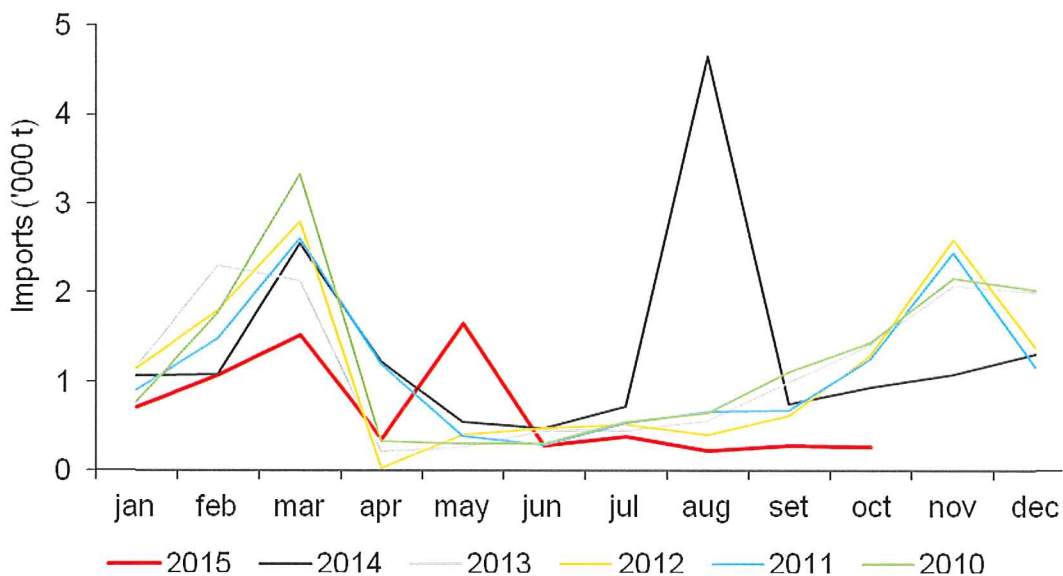


Figure 5. Total Brazilian imports of salted and dried cod from 2010 to 2015 (Oct), by month.
 Source: BRAZIL (2015).

2. METHODOLOGY AND ESTIMATION

The analysis of the import market for salted & dried cod in Brazil is conducted by estimating demand function with price, exchange rate and income as explanatory variables, using the Ordinary Least Squares method. Given that apparent consumption may be defined as the goods consumed in a country (national production + imports – exports) (Abdallah, 1999), the salted & dried cod imports represent the apparent consumption in Brazil, as there is no national production and no exports². However, it is possible to find fish other than cod that has been salted and dried, in the Brazilian market. Therefore, the general model specification is as follows:

$$Qd = \beta_0 + \beta_1 P_c + \beta_2 E_R + \beta_3 I_m + \beta_4 D_m + \varepsilon_i \quad (1)$$

where Qd is the salted & dried import quantities, P_c is the import price of imported salted & dried cod, E_R is exchange rate, I_m is income and, D_m is a dummy. Yearly observations are used for all variables. The annual price of imported salted & dried cod represents the average annual price of imports from Norway and Portugal³, in dollars per kilogram. The exchange rate is represented by the index of the real effective exchange rate (1999 = 100). The income variable is represented by the minimum wage in dollars at purchasing power parity. Finally, a dummy for the period from 1994 to 1999 was included due to the fixed exchange rate in this period. A log-linear model was then formulated. The data used in this analysis were obtained from the Ministry of Development, Industry and Commerce (MDIC), Institute of Applied Economic Research (IPEA), and the Brazilian Central Bank (www.bancn.gov.br), for the period from 1989 to 2014.

Descriptive statistics - mean, median, minimum and maximum values, standard errors, coefficients of variation (CV), bias and kurtosis - are shown in Table 1, corresponding to the variables price of salted & dried cod, exchange rate, income and quantity of salted & dried cod imported from Norway and Portugal, from 1989 to 2014. The statistics percentage 5% and 95% percentage are percentiles of the distribution. For example, up to 63.9 there are 5% percent of the observations of the exchange rate while up to 137.68 there are 95% percent of the observations of the exchange rate. Interv. IQ is the interquantile range, which is equal to the difference between the third quantile and the first and is a measure of statistical dispersion.

² Changes in inventory are disregarded.

³ As there is yet little data for China, we have not included China. The price is calculated as the sum of import value divided by sum of import quantity.

Table 1. Descriptive statistics. n = 26.

	Price	Exchange rate	Income	Demand
Mean	7,7734	87,843	160,16	9,3605e+006
Median	7,4646	80,861	131,96	9,4255e+006
Minimum	5,7298	62,688	80,332	2,5337e+006
Maximum	11,195	144,13	314,99	1,7973e+007
Standards errors	1,4619	20,081	77,532	4,4173e+006
C.V.	0,18806	0,22861	0,48409	0,47190
Bias	0,59401	1,0463	0,74922	0,27970
Kurtosis	-0,27114	0,62231	-0,88012	-1,0482
5% Percentage	5,7565	63,912	80,628	2,8563e+006
95% Percentage	10,986	137,68	311,46	1,7527e+007
Interv. IQ	1,9708	31,762	130,56	8,1023e+006
Missing obs.	0	0	0	0

The estimates of the demand function for salted & dried cod for the sum of Norwegian and Portuguese imports are presented in Table 2. In order to ensure the quality of the estimation, the Breusch-Godfrey test was used to check for autocorrelation, the White test for heteroscedasticity, and the normality test for the residuals. The estimated model presented residual normality, no residual autocorrelation and heteroscedasticity (Table 2).

The estimated coefficients of price, exchange rate and income are all statistically significant. For the price variable, an increase of 1% led to a reduction of 0.66% in the quantity of imports, i.e., demand is inelastic in relation to the price. In the Brazilian market cod is a traditional good with few substitutes, which may explain this estimated coefficient. The low price elasticity of demand for cod is also estimated in other studies (Asche *et.al.* 2005; Anderson, *et.al.* 1997, p.60). For the exchange rate variable, the negative coefficient represents an inverse relationship with the import quantities of cod, i.e., a devaluation of the Brazilian currency led to a reduction in the domestic demand for cod. For the period under consideration, the estimated model indicates that an increase of 1% in the exchange rate led to a reduction in import quantities of cod of 0.978%. However, the effect of the fixed exchange rate period, captured by the dummy variable, was a positive shift in the import quantity of cod, with the estimated coefficient of 0.85. During this period of stabilized inflation and valuation of the Brazilian currency, there was a stimulus to the domestic consumption of cod due to the high purchasing power of the Brazilian population.

An increase in income of 1% caused an increase in demand for salted & dried cod of 1.3%, i.e., an income elastic demand. Moreover, the elasticity is statistically larger than one,

indicating that salted & dried cod is a “luxury” good. Although it is a traditional product in the Brazilian cuisine, mainly higher income groups consume it.

Table 2. Estimates of the dried and salted cod demand function. n = 26.

Independent	Coefficient	Standard Error	t-test	p-value
Constant	14.8863	1.1899	12.51	0.000
Price	-0.6611	0.2722	-2.429	0,024
Exchange rate	-0.978	0.229	-4.254	0.000
Income	1.317	0.107	12.23	0.000
Dummy	0.85	0.114	7.471	0.000
Breusch-Godfrey autocorrelation test				P-value
R-squared not adjusted = 0.034				
Statistic test: LMF = 0.708				0.410
Alternative statistic TR ² = 0.890				0.345
Ljung-Box Q' = 0.936				0.333
White test for heteroscedasticity				
R-squared not adjusted = 0.683				
TR ² test = 17.764				0.167
Residual normality test				0.181

The estimated model allows prediction of demand for the data set, as can be seen in Figure 6. For most years, predicted demand is very close to actual demand and always in the 95% confidence interval.

There are few demand studies for fish in Brazil in the literature. Sonoda *et al.* (2012) estimated an AIDS model for different food products based on household data for the period 1978-2003. The uncompensated and compensated price demand elasticities varied between 0.59 – 0.70 while the uncompensated and compensated income elasticities were in the range 1.03 – 1.08 which is somewhat lower than what is presented in table 2.

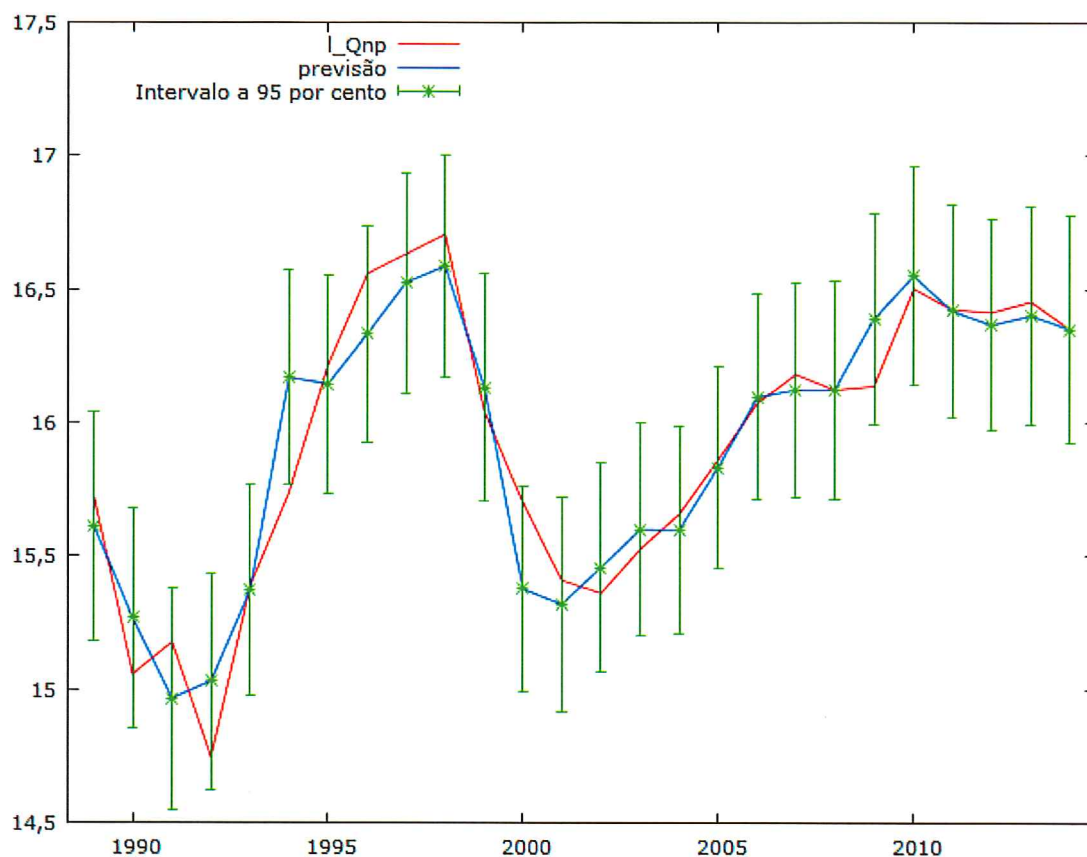


Figure 6. Demand for salted & dried cod: prediction.

Where: Qnp (in red) means demand; previsão (in blue) means prediction; Intervalo a 95 por cento (in green) means confidence interval of 95%.

3. CONCLUSIONS

This paper studied the market for imported salted & dried cod from 1989 to 2014, using a demand analysis to identify the main variables determining the demand for this product and to quantify how much they influence demand.

Salted & dried cod has been imported from Norway for decades and in the empirical analysis, we use data starting in 1989. During the period of fixed exchange rate in Brazil, the product was more available for the Brazilian consumers due to a valorisation of the national currency and thus cheaper imports. Portugal, as the second major player, has increased its share in the imports of salted & dried cod especially since 2000 and is now a major player in the market. More recently, China has taken a small but increasing share of the market, as the country's industry has competitive prices for processed products in the international market.

There have been substantial changes in market share over the period under consideration: while Norway has lost market share, Portugal now represents just over 40% of the market.

Bjørndal *et.al.* (2016a and b) have analysed the development of the Portuguese fish processing industry over recent decades. This industry has expanded greatly for reasons such as EU and domestic incentives with regard to production and export promotion that have improved the competitiveness of the industry. Consequently, the industry has gained market share both in the domestic market and in export markets such as Brazil.

The months before Easter and Christmas are the periods with most imports of salted & dried cod to Brazil. This is expected, and is due to the tradition for consuming salted & dried cod during these holiday seasons. However, daily consumption has been increasing – particularly in restaurants and supermarkets.

The demand analysis for salted & dried cod suggested a negative relationship between the price of salted & dried cod and imports, a negative relationship between the exchange rate and imports, and a positive relationship between income and imports. Moreover, the results suggest an income elasticity of more than one, i.e. changes in households' purchasing power influence consumption and, thus the imports of salted & dried cod. In addition, the demand for salted & dried cod is considered inelastic in relation to the price.

The results presented in this analysis are important for supporting policies in Brazil and in the exporting countries, for both the industry and for the public sector. This study is the first to estimate price and income elasticities for salted & dried cod in the Brazilian market, which is essential when analysing the market in Brazil.

This research can be extended in several ways. If monthly data become available, the number of observations would be much larger. This would also allow for a closer analysis of seasonal effects in consumption. Moreover, with monthly data it might be possible to estimate a demand system including prices of imports from Norway, Portugal or China. Alternatively, a co-integration analysis could be undertaken to investigate whether salted & dried cod from all three countries are in the same market.

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APPENDIX

Table A1. Data.

Year	Real Effective Exchange Rate (1999 = 100)	Average Income (USD)	Salted & dried Import Quantities* (kg)	Salted & dried Import Price USD/kg
1989	73	103	6729078	5,94
1990	63	81	3455544	7,84
1991	75	80	3898800	9,30
1992	85	89	2533700	8,67
1993	82	102	4817929	7,05
1994	77	85	6833185	5,90
1995	69	88	11041895	7,56
1996	66	94	15525436	7,04
1997	66	99	16697406	5,81
1998	67	105	17973474	5,73
1999	100	108	9270151	6,80
2000	94	115	6584415	7,29
2001	112	129	4919454	7,81
2002	107	135	4688575	7,29
2003	107	139	5530386	6,27
2004	104	148	6305153	7,37
2005	89	163	7734576	8,06
2006	81	192	9580770	8,57
2007	76	210	10651095	10,60
2008	81	224	10050584	11,19
2009	81	240	10190595	8,52
2010	73	257	14700908	8,97
2011	81	265	13581033	9,98
2012	105	293	13446230	8,91
2013	126	305	13992338	7,03
2014	144	315	12613153	6,62

* Salted & dried import quantities from Norway and Portugal.

Source: Ministry of Development, Industry and Commerce (MDIC), Institute of Applied Economic Research (IPEA), and the Brazilian Central Bank (www.bancen.gov.br).