Testing the effect of an anti-dumping duty:

The US salmon market

by

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Abstract

During the late 1980s, Norwegian salmon farmers had a market share of over 50% for farmed salmon in the USA. In 1991 a countervailing duty and an anti-dumping duty were imposed on Norwegian exports of farmed salmon to the US which basically closed the market for Norwegian salmon. The primary aim for US farmers was to increase prices on the US market, but also increased US market shares was targeted. In this paper we investigate to what extent the imposed duties on Norwegian salmon was sufficient to reach these goals.

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1. Introduction

During the last decade prices for salmon have been decreasing globally, leading to poor profitability. As a result there has been a number of conflicts in relation to trade with farmed salmon, both in the US and Europe, and several dumping complaints have been filed.[1] Most of these complaints have been targeted at Norway, which is the world's largest producer of farmed salmon, with a share of production of over 40%, but recently US farmers also filed a complaint against Chilean farmers.

Following a complaint filed in 1989, Norwegian farmers were found guilty of dumping salmon in the US and in receiving subsidies. From April 12, 1991, anti-dumping and countervailing duties were imposed on Norwegian salmon. The duties were 26% on average, but varied somewhat for different firms.[2] As noted in Anderson (1992), and also evident in Figure 3, this effectively closed the US market for Norwegian salmon. Following a complaint in 1997, in June 1998, the US Department of Commerce also found Chilean farmers guilty in dumping salmon on the US market. After having faced a temporary duty since January, Chilean salmon faces an anti-dumping duty of 5.19 % for most firms from June 9th, 1998.[3]

For US salmon farmers, the purpose of the dumping complaints was not primarily to close the US market for Norwegian and Chilean salmon. Rather, this was a mean in an attempt to increase prices on the US market, and possibly also to increase US farmers' market share. In this paper we will investigate whether the duties imposed on Norwegian salmon succeeded on these accounts. Although this investigation is of interest in itself, the

[1] An overview of these trade conflicts can be found in Asche (1997a). Anderson and Fong (1997) is also of interest with respect to trade and the Norway/US case.
[2] The duties are an equalization tariff on 2.27% and a anti-dumping duty varying from 15.65% to 31.8%.

implications of the results with respect to market structure is also of interest given the recent complaint and ruling against Chilean farmers. The analysis will be carried out by investigating the relationship between the price of fresh salmon at the US market and the two other main markets for fresh salmon; the EU and Japan.

2. Background

There has been a tremendous increase in production of farmed salmon from the early 1980s. In Table 1, total production, Canadian, Chilean, Norwegian, Scottish and US production are shown for the period 1982-1996. Norway is clearly the largest producer, although the Norwegian share of production has been declining. Chile did not start production of farmed salmon until the mid 1980s, and did not become a significant producer until the late 1980s. However, in relative terms, Chile has been the fastest growing producer during the last years.[4] Also, Canada and Scotland are major producers, and both globally and at the US market, US producers play a limited role.

The increase in worldwide production of salmon has been accompanied by a substantial decrease in prices. Real Norwegian export prices in 1995 was only 37% of the price in 1982. The fall in prices can to a large extent be explained by increased productivity, as real production cost in 1995 was only 36% of the production cost in 1982 (Asche, 1997a). Another reason for falling prices might be that landings of wild Pacific salmon increased by almost 50% during the 1980s. The falling prices, together with the

[3] Two firms face no duty, one firm a duty on 2.24%, one firm on 8.27% and one firm on 10.91%.

[4] While most farmed salmon is Atlantic salmon, it might also be of interest to note that Chile also produce substantial quantities of coho. Around 1990, some of the exports to the US was coho. However, today Chile exports only Atlantic salmon to the US, while their coho goes to Japan. Canadian farmers has also produced up to 10 000 tonnes of chinook, of which a substantial share is exported to the US.

fact that it takes between one and two years from the decision to produce a salmon is made until it is ready for the market, has in periods lead to poor profitability in the industry.

Salmon is mainly consumed in three markets; the EU, Japan and the US. While it is mainly farmed salmon that is consumed in the EU, wild Pacific salmon is the most important species in Japan and the US. It may be of interest to note that farmed salmon is mostly Atlantic, and is mainly marketed as fresh, while wild Pacific salmon is frozen.[5] Several demand studies indicate that Pacific and Atlantic salmon are substitutes, with the most highvalued Pacific species as the closest substitutes (Herrman, Mittelhammer and Lin, 1993; DeVoretz and Salvanes, 1993; Asche, Bjørndal and Salvanes, 1998), and that different product forms of salmon (fresh, frozen, salted) also are substitutes (Wessells and Wilen, 1993; 1994; Asche, 1996; Asche, Salvanes and Steen, 1997). However, US farmers were in the dumping case against Norwegian salmon successful in arguing that the market for fresh farmed salmon was separate from wild Pacific salmon. Only data on fresh farmed salmon will therefore be considered here.

When one views fresh farmed salmon as a separate market, a striking feature is that producers outside the main markets, Norway and Chile, produce most of the salmon (see Table 1). However, both in the US and in the EU (Scotland and Ireland), there is also a domestic production. In periods with poor profitability, the nondomestic producers may seem like, and have been, tempting targets to reduce competition. As mentioned above, US farmers first succeeded in excluding Norwegian farmers from the market, and have

[5] Troll caught salmon of the US west cost, mostly chinook, are mainly consumed as fresh, and do most likely compete directly with fresh Atlantic salmon. However, as the available quantities are small (1,500 to 3,000 tonnes), these quantities are not very important.

recently also tried to exclude Chilean farmers. In Europe, three dumping complaints have been filed against Norwegian farmers, so far without any success. However, a number of minor trade regulating measures have been implemented.

3. Data

Monthly import prices for fresh salmon in the three main markets have been collected from the EU, Japan and the US trade statistics for the period January 1989 to September 1996. One might have wished a price in the US where US salmon was included, but such data was not available. However, personal communication with James L. Anderson at University of Rhode Island indicates that import prices is a very good indicator of prices of US farmed Atlantic salmon. This is also as expected, since the US production is minor compared to the imports even after Norwegian salmon was excluded from the market (mostly less then 20%), and there is no trade barriers for salmon from other nations. The same potential problem is present in the EU, as the Irish and Scottish production consumed domestically is not included.[6] However, given the results of Asche and Sebulonsen (1998), where the relationship between wholesale prices in UK and France is investigated, one would not expect this to matter to any extent.

Before a statistical analysis of the relationships can be carried out, we must investigate the time series properties of the data. Dickey-Fuller tests (Dickey and Fuller, 1979; 1981) were carried out for the price series. The lag length was chosen as the highest significant lag. Six lags were used for all prices in levels, and five for the first differences. All prices are found to be nonstationary, but stationary in first differences (Table 2). These

[6] Irish and Scottish exports to other EU members are included in the numbers.

results are independent of the selected lag length. Hence, cointegration analysis is the appropriate tool when investigating the relationships between the prices.

4. Cointegration

When data series are nonstationary, normal inference theory breaks down. A data series is said to be nonstationary when its mean and variance are not constant.[7] Cointegration analysis has been developed as a tool for such data. Two different tests for cointegration are commonly used in the literature. They are the Engle and Granger test (Engle and Granger, 1987) and the Johansen test (Johansen, 1988; 1991). We will here use the latter, since hypothesis testing on the parameters in the cointegration vector is possible only in this framework.

The Johansen test is based on a vector autoregressive system. With a vector $\boldsymbol{x}_t$, containing the N variables, this can on error correction form be written as;

$$\Delta \mathbf{x}_t = \sum_{i=1}^{k-1} \Gamma_i \Delta \mathbf{x}_{t-i} + \Pi_K \mathbf{x}_{t-k} + \mu + e_t \qquad (1)$$

Here, Π_K contain the long-run relationships. If $\boldsymbol{x}_t$ is a vector of $I(1)$ variables, the left-hand side and the first (k-1) elements of (3) are $I(0)$, and the last element of (1) is a linear combination of $I(1)$ variables. This last element must also be $I(0)$; $\Pi_K x_{t-k} \sim I(0)$. Hence, either $\boldsymbol{x}_t$ contains a number of cointegration vectors, or Π_K must be a matrix of zeros. The rank of Π_K, r, determines how many linear combinations of $\boldsymbol{x}_t$ are stationary. If $r=N$, the

[7] For a more precise notion of nonstationarity, nonstationary data series are often labeled depending on how many times they have to be differenced to yield a stationary data series. A data series that has to be differenced once to become stationary is said to be integrated of order one, denoted $I(1)$. Most economic data series seem to be integrated of order one.

variables in levels are stationary; if r=0 so that Π_K=0, none of the linear combinations are stationary. When 0<r<N, there exist r cointegration vectors. In this case one can factorize Π_K; $-\Pi_K = \alpha\beta'$, where both α and β are (N×r) matrices, and β contains the cointegration and α the adjustment parameters. Two asymptotically equivalent tests exist in this framework, the trace test and the maximum eigenvalue test.

The Johansen procedure allows hypothesis testing on the coefficients α and β, using likelihood ratio tests (Johansen and Juselius, 1990). In our case, it is restrictions on the parameters in the cointegration vectors β which is of most interest. Since this allow us to test for the Law of One Price (LOP).[8]

5. Empirical analysis

We will here investigate whether the duties imposed on Norwegian salmon imports to the US had any effect on prices or market shares. To investigate whether the duties had any effect on prices, we test whether there is a global market for farmed salmon. We then look at the development of market shares at the US market.

A number of market definitions are based on the relationship between prices. For instance, Stigler (1969, p. 85) defines a market as "the area within which the price of a good tends to uniformity, allowances being made for transportation costs".[9] Marked definitions like this has lead to an extensive literature testing for market integration based on the relationship between prices. The relationship between Stigler's (1969) market

[8] Recently, a number of studies have used cointegration analysis to investigating relationships between prices. Examples related to seafood products are Gordon, Salvanes and Atkins (1993), Bose and McIlgrom (1996), Gordon and Hannesson (1996), Asche, Salvanes and Steen (1997) and Asche and Sebulonsen (1998).

definition and cointegration is evident. In Stigler's definition, a stable long-run relationship between prices implies that goods are in the same market. For nonstationary prices, cointegration is the only case when these form a stable long-run relationship.

The most important aim with the duties against Norwegian salmon was to increase prices for farmed salmon in the US. This is only possible if the US market is not a part of a global market for farmed salmon. Hence, to investigate if one succeeded, we will first test whether there is a global market for fresh farmed salmon. This is done by analyzing the relationship between import prices in the three main markets for farmed salmon; the EU, Japan and the US. Provided that there is one market, one can test whether the duties on Norwegian salmon to the US managed to rise prices in the US market by testing whether the US price increased compared to prices in other markets.

The prices are graphed in Figure 1. The price level in Japan is substantially higher than in the EU and the US. This is because of higher transportation cost to Japan. All prices do, however, seem to follow the same long-run trend. For EU and Japan, also the short-run movements seem to follow each other closely, while the US price seem to have more independent short-run movements. This is not unreasonable, since the fresh markets in the EU and Japan are virtually only Atlantic salmon with Norway as the largest supplier, while also some Pacific salmon, mainly chinook, are available as fresh in the US, and with Canada and Chile as the most important suppliers.

[9] A similar definition, but where transportation costs are replaced by quality differences can be used in product space (Stigler and Sherwin, 1985).

The cointegration tests were carried out using the Johansen test (Johansen, 1988).[10] Both pairwise and a multivariate test were carried out. All prices are pairwise cointegrated, and the multivariate test indicates two cointegration vectors (Tables 3 and 4). Furthermore, the LOP cannot be rejected in any of the pairwise relationships. With a test statistic of 0.515 which is $\chi^2(2)$ distributed, the hypothesis cannot be rejected in the system. Hence, the market for salmon seems to be well integrated.

Given that there is one salmon market, we introduced dummies both on the constant terms and on the slope coefficient for the US price after April 1991 to test whether the duties on Norwegian salmon had an impact on prices in the US. A *F*-test of whether the parameter on all these shift variables was zero gave a test statistic of 1.136. As the critical value for $F(15,212)$ at a 5% level is 1.71, we cannot reject the null hypothesis of no shift. A test of whether there was a shift in only the constant terms (proportionality coefficients) gave a test statistic of 1.211. As the critical value for $F(9.192)$ at a 5% level is 1.91, we cannot reject the null hypothesis of no shift. The last test performed was whether there was only a short-run impact on the constant terms (proportionality coefficients). This gave a test statistic of 1.021. As the critical value for $F(6,160)$ at a 5% level is 2.27, we cannot reject the null hypothesis of no shift. Accordingly, the US duties on Norwegian salmon do not seem to have lead to an increase in the price of farmed salmon on the US market.

[10] Two lags were used in the test, as this seemed sufficient to avoid serial correlation in the residuals. In the system, a LM test for serial correlation up to 12 lags gave a test statistic of 1.073. It is distributed as F(108, 138). With a critical value of 1.36 for a F(100,125), we cannot reject the null hypothesis of no autocorrelation.
We also tested whether one should allow for a trend in the short-run dynamics. With a test statistic of 1.12 that is distributed as $\chi^2(1)$, we cannot reject the null of no trend in the short-run dynamics.

Our econometric analysis indicate that the prices in the three main markets for salmon form a long-run relationship over the whole period. The prices follow the same stochastic trend and is therefore exposed to the same long-run shocks (innovations). Also, the Law of One Price seems to hold. Hence, there seems to be a well integrated global market for salmon. Furthermore, there is no evidence that the US duties on Norwegian salmon had an effect on the development of US prices.

An argument in favor of a duty, even if the duty does not have any effect on prices is that it might increase the share of domestic produce on the market. In Figure 2, the total available quantity of fresh salmon at the US market is graphed together with US supply of farmed Atlantic salmon. It is clear that the supply increased over the period, and the exclusion of Norway as a supplier did accordingly not have any impact on the supplied quantity to the market. However, it is interesting to note that from 1993, the increasing trend for US production is reduced. With a lag of two years from the decision to produce a salmon is made until it has market size, this is just when one would expect that US production should increase if the duties on Norwegian salmon were beneficial to the US industry. The quantity shares at the US market is shown in Figure 3. The US share increases until 1992, while it is relatively constant thereafter. Hence, neither US production nor US market share seems to have benefited from the duties.

However, it is also clear from Figure 3, that Canadian and Chilean market shares increased substantially after Norwegian salmon was excluded. The only traceable effect of the US duties on Norwegian salmon therefore seem to be a reallocation of trade patterns, where Canadian and Chilean salmon took over from Norwegian salmon. Given that the chance of succeeding with profit shifting measures decrease with increased market

integration even when the different actors have some market power (Markusen and Venables, 1988; Brander, 1995), this outcome is as expected given that the markets in the EU, Japan and US seem to be well integrated. However, it might be of interest to note that with the complaint against Chilean farmers, also US farmers seem to have reached the conclusion that excluding Norwegian salmon from the market did not help them very much.

Concluding remarks

The US market for fresh salmon seem to be well integrated with the other main markets for fresh salmon, indicating that there is a world market for fresh salmon. Even though Norway is the worlds largest supplier of fresh salmon, excluding Norwegian salmon from the US market is then not sufficient to raise prices when other producers has enough capacity to supply the US market. It is therefore not surprising that duties on Norwegian salmon did not benefit US farmers to any extent, but only lead to other producers taking over Norwegian salmon market share. Further, since there is more than enough salmon available to supply the US market even if Chile is excluded, it is not very likely that an exclusion of Chile from the US market will benefit US farmers to any extent. It might then be just as well that the duty imposed on Chilean salmon are so low that it is not likely to have any impact. The best news based on these results are that whatever the outcome of the trade conflicts, US consumers do not seem to lose.

Table 1. World salmon production

Year	Total	Canada	Chile	UK	Norway	USA
1981	11.8	0.3	-	1.1	8.4	0.5
1982	16.3	0.3	-	2.2	10.7	0.7
1983	24.4	0.3	-	2.5	17.3	0.9
1984	33.9	0.3	0.1	3.9	22.3	1.1
1985	48.2	0.4	0.5	6.9	29.5	1.5
1986	70.6	1.1	1.1	10.3	45.7	1.2
1987	86.1	3.1	1.8	12.7	47.4	1.6
1988	142.2	9.9	4.2	18.0	80.5	2.5
1989	207.1	16.9	8.8	28.6	110.1	3.6
1990	274.8	18.5	23.3	32.0	146.0	3.6
1991	328.0	29.0	34.1	40.7	154.9	7.2
1992	310.6	30.3	46.6	36.3	124.1	10.3
1993	371.4	32.7	55.2	48.8	163.6	13.2
1994	444.1	33.5	69.1	64.3	205.7	14.0
1995	531.9	40.8	103.0	72.0	249.0	17.0
1996	640.5	41.7	144.0	83.0	292.0	18.0

Sources: Bjørndal (1990), FAO database, Kontali Analyse

Table 2. Dickey Fuller tests

Variable	Price levels		First differences	
	with constant	with trend	with constant	with trend
USA	-0.231	-1.042	-5.811*	-5.840*
EU	-0.189	-0.827	-6.355*	-6.744*
Japan	-0.298	-1.343	-6.092*	-6.391*

*Indicates significant at a 1% level and ** indicates significant at a 5% level. Critical values are at a 5% level with constant -2.893 and with trend -3.451 (MacKinnon, 1991).

Table 3. Bivariate Johansen tests for cointegration and LOP

Variables	H_0:rank = p	Max test	Trace test	Law of one Price
USA and Japan	p == 0	32.79*	37.23*	0.423
	p <= 1	4.44	4.44	
USA and EU	p == 0	26.77*	30.42*	0.369
	p <= 1	3.65	3.65	
EU and Japan	p == 0	20.78*	25.46*	0.899
	p <= 1	4.68	4.68	

*indicates significant at a 1% level and ** indicates significant at a 5% level.

Table 4. Multivariate Johansen test

H_0:rank = p	Max test	Critical value 5%	Trace test	Critical value 5%
p == 0	33.90*	22.0	58.67*	34.9
p <= 1	20.36*	15.7	24.77*	20.0
p <= 2	4.41	9.2	4.41	9.2

*indicates significant at a 1% level and ** indicates significant at a 5% level.

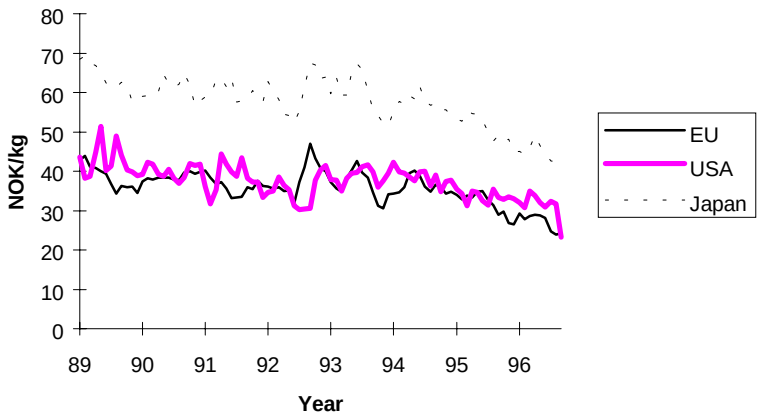

Figure 1. Import prices for fresh salmon to the EU, Japan and the US

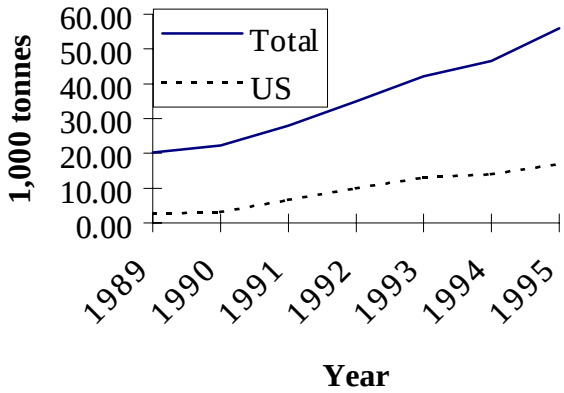

Figure 2. Available quantities of Fresh farmed salmon at the US market.

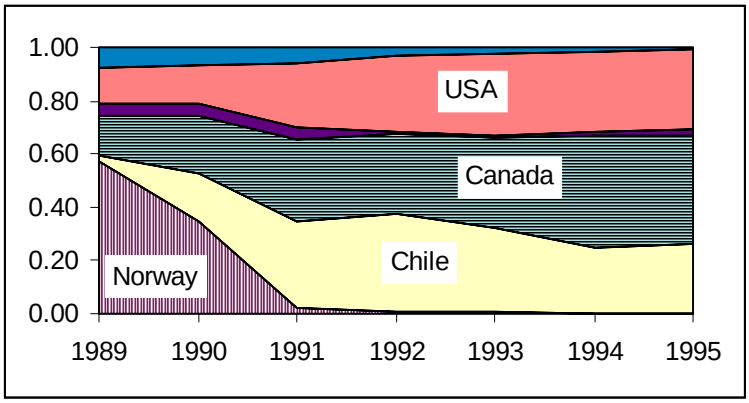

Figure 3. Quantity shares for fresh farmed salmon at the US market.

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