FUTURE SUPPLY AND PRICE OF NORWEGIAN ATLANTIC SALMON

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INTRODUCTION

Recent concerns over health and diet have greatly enhanced the demand for highly valued fresh and frozen seafood and, hence, their prices. This strong demand for seafood has also stimulated increased interest in culturing highly priced species in captivity. With Norway's dramatic success in farming Atlantic salmon and the proliferation of salmon farming worldwide, worldwide supply of salmon is expected to grow substantially in the near future.

The United States (U.S.) and the European Community (EC) have been targeted as major markets for farmed salmon. Since 1984, the U.S. and France have been the top two leading importers of pen-raised Atlantic salmon from Norway. In 1987, the U.S. imported 18 million pounds of Norwegian Atlantic salmon, which was more than the 11 million pounds of chinook (spring) landed in Canada and about half of the 39 million pounds of chinook landed in the U.S. In fact, Norway produced 94 million pounds of Atlantic salmon in 1987 which was not far from the North American combined chinook and coho landings of 136 million pounds.

By 1990, it is predicted that the supply of farmed salmon will reach 480 million pounds, which will consist of 342 million pounds of Atlantic salmon and 138 million pounds of Pacific salmon (U.S. Department of Commerce, 1987). This combined production of farmed salmon will represent about 40-50% of the projected 1990 wild salmon catch in the U.S. and Canada, while farmed production was only 18% of the catch in 1987. If the lower-priced salmon species of chum and pink are excluded, the projected production of farmed Atlantic salmon in 1990 nearly matches the projected catch of chinook, coho, and sockeye salmon in the U.S. and Canada.

It is well known that the price of a commodity is determined by its demand and supply conditions. Because both the demand and supply of salmon will continue to grow, the future movement in salmon price is therefore unclear. The purpose of this paper is to integrate econometric and time series modelling for forecasting the price of Norwegian Atlantic salmon for the period from 1989 through 1991.

The market conditions for Norwegian Atlantic salmon in the U.S. and the EC are estimated as a simultaneous equation model. The econometric model includes three structural equations representing the demand and supply of Norwegian Atlantic salmon in the U.S. and the demand for Norwegian Atlantic salmon in the EC. The Box-Jenkins time-series analysis is conducted to forecast future values of some of the determinants of salmon demand. The estimated econometric and time series models are then combined via dynamic simulation to generate future supply and price of Norwegian Atlantic salmon in the U.S. and EC.

The following section provides a brief discussion of the econometric model and empirical results; next, future values of the determinants of the demand for Norwegian Atlantic salmon are presented; and finally, future supply and price of Norwegian Atlantic salmon are summarized.

THE ECONOMETRIC MODEL

Since the U.S. and the EC are the major export markets for Norwegian Atlantic salmon, two regional demand functions are specified in the simultaneous equation model. In addition, the allocation of Norwegian fixed supply between the U.S. and EC is also included in the model. In total, there are three structural equations and four identities specified as:

$$(1) \quad Q_{usd} = f(P_{us}, PS_{us}, Y_{us}, D)$$
$$(2) \quad Q_{ecd} = g(P_{ec}, PS_{ec}, Y_{ec}, D)$$
$$(3) \quad Q_{uss} = h(NP_{us}, NP_{ec}, STOT, Q_{uss,t-1})$$
$$(4) \quad Q_{usd} = Q_{uss}$$
$$(5) \quad Q_{usd} + Q_{ecd} = STOT$$
$$(6) \quad NP_{us} = P_{us} * ER_{us} * WPI_{us}$$
$$(7) \quad NP_{ec} = P_{ec} * ER_{ec} * WPI_{ec}$$

where Q_{usd} and Q_{ecd} are the demand for Norwegian Atlantic salmon in the U.S. and EC, respectively; Q_{uss} is the supply of Norwegian Atlantic salmon to the U.S.; P_{us} and NP_{us} are the U.S. prices of Norwegian Atlantic salmon in U.S. dollars and Norwegian kroners, respectively; P_{ec} and NP_{ec} are the prices of Norwegian Atlantic salmon in the EC measured in the European Unit of Account (ECU) and kroners, respectively; PS_{us} is the exvessel price of chinook salmon in the U.S.; PS_{ec} is the FOB prices of chinook, sockeye, and coho salmon exported from the U.S. and Canada to the EC; Yus and Y_{ec} are income variables for the U.S. and EC, respectively; D represents a vector of monthly indicator variables; STOT is the total Norwegian exports to the U.S. and EC; ER_{us} and ER_{ec} are the number of kroners per U.S. dollar and ECU, respectively; and WPI_{us} and WPI_{ec} are the wholesale price indexes in the U.S. and EC, respectively. All monetary variables are expressed in real terms in equations (1) and (2) and in nominal terms in equation (3).

The specification of the demand for Atlantic salmon follows economic theory in that the quantity consumed is hypothesized to be affected by its own-price, prices of substitutes, and income. Monthly dummy variables are included to capture seasonal variation in consumption.

A 1985 study by the Aquaculture Project Group of the National Marine Fisheries Service states that chinook is a strong competitor with Norwegian Atlantic salmon in the U.S. Rogness and Lin (1986) reported that U.S. seafood wholesalers in general consider fresh Atlantic salmon from Norway and fresh Pacific salmon to be substitutes; therefore, it is hypothesized that Norwegian Atlantic salmon and fresh chinook are substitutes in the U.S. The wholesale price of fresh chinook is not available from government sources. Because the wholesale price and the exvessel price of Pacific salmon are closely related in actual trading (Dart, 1988), the exvessel price can be used as a proxy for the wholesale price in the U.S. demand equation. Population is fairly constant during the sample period, so consumption of Atlantic salmon and income in the U.S. are expressed in terms of total quantity and income instead of on a per capita basis. Real income is defined as income deflated by the wholesale price index.

The EC region includes all of its member countries. Income for the EC is a simple aggregate of its member countries' incomes. The price of Norwegian Atlantic salmon is the total value of EC's imports divided by the quantity. Little is known regarding the relationship between Pacific salmon and Atlantic salmon consumption in Europe. Since both Atlantic and highly-valued Pacific salmon (chinook, sockeye, and coho) are used for smoking, it is hypothesized that chinook, sockeye, and coho are substitutes for Norwegian Atlantic salmon. The price of chinook, sockeye, and coho is the total value of imports from the U.S. and Canada divided by the quantity. The Organization for Economic Cooperation and Development (OECD) reports the EC consumer and producer price indexes but not the wholesale price index in Main Economic Indicators. Because consumer and producer price indexes in the EC are highly correlated, the producer price index (PPI) is used to derive real monetary variables which are expressed in terms of ECUs.

Norway is the leading producer of farmed Atlantic salmon by a wide margin. All Norwegian salmon farmers are members of the Norwegian Fish Farmers Sales Association which links producers and processors (Shaw and Muir, 1987), who in turn, deal with licensed exporters. Price information is fed back from the exporters to the producers through the Fish Farmers Sales Association (Gordon, 1985). Therefore, it is likely that the Association has some market power and hence allocates its fixed supply to the U.S. and EC according to prices offered by these two markets. It is hypothesized that Norwegian exports to the U.S. will respond positively to the U.S. price and negatively to the EC price. These two prices are measured in Norwegian kroners in nominal terms. The lagged supply is included as a result of the Nerlove adjustment process in which the change in the supply to the U.S. will respond only partially to the difference between the desired allocation and the past allocation. The reason for including this friction is that Norwegian exporters are not completely responsive to prices. There is a certain number of goodwill and long-term trading agreements between exporters and wholesalers. Many smaller exporters have developed trading niches (Bjorndal, 1988) whereby maintaining good relations between the exporter and wholesaler may be more important than short-run price differences. Total supply is assumed to be fixed and is expected to have a positive effect on the supply to each region.

The assumption of fixed supply may not be realistic, and consequently, the model may not be completely free from a simultaneous equation bias. In order to endogenize the total supply, additional monthly information such as feed and smolt costs, inventories of different sizes of fish, occurrence of disease problems caused by increased density, technological improvement, and the number of licensed farms need to be collected, and price expectations need to be modeled. Some of these variables are difficult, if not impossible, to obtain or quantify. Therefore, total supply is assumed to be fixed in this study.

Equations (4)-(7) are identities. The model is complete with seven equations and seven endogenous variables--Q_{usd}, Q_{ecd}, Q_{uss}, P_{us}, P_{ec}, NP_{us}, and NP_{ec}. It is well known that exchange rates have significant impacts on prices and trade flows. Incorporation of exchange rates into the model via (6) and (7) allows analysis of the effects of changes in exchange rates on the supply and price of Norwegian Atlantic salmon in the U.S. and EC.

Data Sources

Norwegian monthly exports of Atlantic salmon by country from January 1983 through March 1987 were provided by the Norwegian Central Bureau of Statistics. The prices of Norwegian Atlantic salmon in the U.S. (dollars per pound) and the EC (ECUs per pound) are FOB (free-on-board) prices and are derived from dividing import value by quantity (million pounds). The exvessel price (dollars per pound) of chinook salmon (PS_{us}) in the state of Washington is reported in the Fishery Market News by the National Marine Fisheries Service. The exports of Pacific salmon from the U.S. to the EC were taken from the U.S. Exports for Consumption published by the Bureau of Census, Department of Commerce. The Canadian exports of salmon to the EC are reported in Trade of Canada: Exports by Commodities by Statistics Canada. The U.S. income (disposable personal income measured in billions of dollars) and the wholesale price index (1967 is the base year) of food and feeds are from the Survey of Current Business published by the Department of Commerce. The producer price index (1980 is the base year) of EC member nations are available from the Main Economic Indicators published by the OECD. The income for the EC (gross disposable product measured in billions) and the exchange rates are available in the International Financial Statistics published by the International Monetary Fund.

Empirical Results

Monthly data from January 1983 through March 1987 were used to estimate the econometric model. The linear and double-log functional forms of equations (1)-(3) were estimated, and the linear functional form was found to produce a statistical fit to historical data that was somewhat better than its counterpart (Herrmannn and Lin, 1988). However, the linear functional form was found to be unsatisfactory for extrapolating model variables into the future. The Norwegian Atlantic salmon market is still in its infancy and is expected to grow substantially in the near future. It would appear that the dynamic nature of demand shifts would need to be more accurately modeled for a multiperiod analysis from a linear model. The double-log functional form also produced a good statistical fit to the historical observations and provided more reasonable results when extrapolating the effects of dramatic increases in Norwegian production on prices, so it is used to forecast future supply and price of Norwegian Atlantic salmon in the U.S. and EC. The empirical results of the two-stage least squares method are summarized below with the absolute values of t statistics in parentheses.

$$
\begin{aligned}
(8)\quad \ln Q_{usd} = {} & -11.0 - \underset{(2.1)}{3.35}\ln P_{us} + \underset{(6.4)}{0.36}\ln PS_{us} + \underset{(1.2)}{5.09}\ln Y_{us} - \underset{(0.3)}{0.06}D1 \\
& - \underset{(0.8)}{0.29}D2 - \underset{(0.3)}{0.10}D3 + \underset{(0.2)}{0.08}D4 - \underset{(0.8)}{0.23}D5 - \underset{(1.6)}{0.44}D6 - \underset{(2.8)}{0.69}D7 \\
& - \underset{(3.1)}{0.72}D8 - \underset{(3.8)}{0.81}D9 - \underset{(3.3)}{0.67}D10 - \underset{(0.3)}{0.06}D11 \\
R^2 = 0.885, \quad & \text{Adj. } R^2 = 0.840, \quad \text{Durbin-Watson} = 2.08
\end{aligned}
$$

$$(9)\quad \ln Q_{ecd} = \underset{(7.5)}{6.9} - \underset{(4.0)}{1.52}\ln P_{ec} + \underset{(3.4)}{0.28}\ln PS_{ec} + \underset{(1.3)}{2.52}\ln Y_{ec} - \underset{(7.3)}{0.64}D1$$

$$- \underset{(6.3)}{0.66}D2 - \underset{(4.3)}{0.48}D3 - \underset{(4.3)}{0.50}D4 - \underset{(2.7)}{0.36}D5 - \underset{(1.8)}{0.23}D6 - \underset{(3.1)}{0.36}D7$$

$$- \underset{(4.7)}{0.55}D8 - \underset{(3.9)}{0.46}D9 - \underset{(4.0)}{0.42}D10 - \underset{(2.6)}{0.23}D11$$

$R^2 = 0.967$, Adj. $R^2 = 0.954$, Durbin-Watson = 1.94

$$(10)\quad \ln Q_{uss} = \underset{(2.7)}{-5.78} + \underset{(3.5)}{3.82}\ln NP_{us} - \underset{(2.9)}{3.44}\ln NP_{ec} + \underset{(5.4)}{0.72}\ln STOT$$

$$+ \underset{(6.5)}{0.51}\ln Q_{uss,t-1}$$

$R^2 = 0.886$, Adj. $R^2 = 0.876$, Durbin-h = 0.9

where Dt is a monthly indicator variable which is equal to one for the t^{th} month and zero for other months. All estimated coefficients, excluding indicator variables, have signs consistent with <u>a priori</u> theoretical expectations and are significant at a 1% probability level with the exception of the substitute prices in the U.S. and EC. Judging from t statistics, R^2, and other summary statistics, the above results appear to be satisfactory.

TIME SERIES MODELS

There are nine variables (PS_{us}, PS_{ec}, Y_{us}, Y_{ec}, STOT, ER_{us}, ER_{ec}, WPI_{us}, and WPI_{ec}) which are considered to be exogenous for the purpose of this modelling effort and whose future values need to be generated for forecasting the future supply and price of Norwegian Atlantic salmon in the U.S. and EC. A more realistic model would endogenize PS_{us}, PS_{ec}, and STOT, and this is currently being attempted as research on the salmon market continues. Time series analysis is conducted to forecast future values of all exogenous variables except STOT, ER_{us}, and ER_{ec}, PS_{ec}. After consulting with the Norwegian Ministry of Fisheries and a report by the National Marine Fisheries Service (1987), production of Norwegian Atlantic salmon is assumed to grow by an annual increment of 10,000 metric tons starting from 80,000 metric tons produced in 1988 (1). Exchange rates are volatile and difficult to forecast. ER_{us} is assumed to be equal to 6.74 and ER_{ec} equal to 7.82 for the forecasting period. The price of salmon in the EC was also not satisfactorily forecasted using time series analysis and, therefore, was held constant at 2.35 ECU's per pound which represents the last few quarters' average prices. This should only have a minor effect on the forecasts, however, since the effect of this variable on Atlantic salmon prices is very small.

Five time series models are estimated using monthly data from January 1982 through March 1987. Results are summarized below with the absolute values of t statistics in parentheses.

(11) $\nabla \ln Y_{us} = \underset{(6.9)}{0.006} + (1 - \underset{(2.4)}{0.29})E1$

RMSE = 27.72, MAE = 19.35, ME = -0.95, Theil U = 0.01, RMPE = 0.01048

(12) $\nabla Y_{ec} = \underset{(4.8)}{3.302} + (1 - \underset{(8.6)}{0.762}B + \underset{(2.3)}{0.203}B^4)E2$

RMSE = 13.3, MAE = 9.66, ME = -0.90, Theil U = 0.024, RMPE = 0.0234

(13) $(1 - \underset{(5.5)}{0.72}B)\ \nabla_{12} PS_{us} = (1 - \underset{(2.2)}{0.41}B - \underset{(2.8)}{0.59}B^{12})E3$

RMSE = 34.82, MAE = 26.4, ME = 5.86, Theil U = 0.18, RMPE = 0.1747

(14) $\nabla\nabla_{12} WPI_{us} = (1 - \underset{(1.7)}{0.276}B^3 - \underset{(3.0)}{0.724}B^{12})E4$

RMSE = 2.39, MAE = 2.07, ME = -0.35, Theil U = 0.009, RMPE = 0.00894

(15) $(1 - \underset{(7.4)}{0.874}B)\ \nabla \ln WPI_{ec} = \underset{(2.5)}{0.004} + (1 - \underset{(3.5)}{0.659}B)E5$

RSME = 1.00, MAE = 0.72, ME = -0.28, Theil U = 0.007, RMPE = 0.00707

where ∇ is the first-order difference operator and $\nabla_i Y_t = Y_t - Y_{ti}$; B is the backward shift operator and $B^i Y_t = Y_{t-i}$; and E_i is the error term.

The forecasted values of exogenous variables are summarized in Table 1. Due to space limitations, quarterly data are presented (STOT is the sum and other variables are simple averages of monthly data).

FUTURE SUPPLY AND PRICE OF NORWEGIAN ATLANTIC SALMON

Given the forecasted values of all exogenous variables, the estimated econometric model can be solved, using the computer package Time Series Processor (TSP), to generate the future supply and price of Norwegian Atlantic salmon in the U.S. and EC as shown in Table 2.

It is important to note that the forecasted values presented in Table 2 are conditional on the predicted values of exogenous values discussed in the previous section. Time series models predict that U.S. and EC income figures will follow an upward trend during the prediction period. The exvessel price of chinook in the U.S. is predicted to repeat a seasonal pattern, and the FOB price of chinook, sockeye, and coho is set at a constant. These predictions may or may not materialize. Exchange rates are assumed to be constant, but in reality

they will generally vary. However, it is important to point out that the econometric model can be used to generate future supplies and prices under alternative predictions of the exogenous variables.

From Table 3 it is clear that from 1982 to 1987 prices have undergone a great deal of fluctuation. In the U.S., prices were relatively stable at around $2.85-$3.25 from 1982-1985 but then dropped as low as $2.50 in 1986. In 1987, prices have risen as high as $3.95. For the increased supply of 1989, we predict Norwegian FOB export prices to be around $2.60-$2.80, given the previously predicted exogenous variables and the constant exchange rates. For 1990-1991, we predict the stabilizing of prices at around $2.70-$3.10 which characterized 1982-1985. This long-run forecast would be a price decrease of about 20-25% of the 1987 level but a price increase of 5-10% of the low prices of 1986.

In the E.C., prices have behaved in a similiar fashion. There was a general rise in prices through 1984, peaking in the middle of 1985, then a dramatic depression until the second quarter of 1987. In 1989, we predict prices in the EC will hit the lower levels of 1986 and only rise slightly in the early 1990's. This would be about a 30% decrease of the highs of the 1987 prices of around 3 ECU's. Again, the predicted production levels in the future years can be varied to generate different predictions of future allocations and prices. For example, if salmon production in Norway for 1989 has been overestimated, the prices predicted will be too low. When better information about 1989 becomes available, it will be possible to use this information to obtain more accurate predictions. It should be remembered that wholesale prices in these importing regions will be substantially higher than Norway's FOB export price.

Norway is the leading producer of farmed salmon by a large margin, but other countries such as Scotland and Chile have also engaged in large-scale almon farming. It is expected that non-Norwegian suppliers will compete with Norway in the U.S. and EC markets. As these competing supplies increase in volume, it would be expected that downward pressure would be exerted on Norwegian price, so that in this context the predictions of Norwegian price presented in this paper might be considered high if a large amount of other farmed salmon hit the market.

SUMMARY

Future prices of farmed Atlantic salmon are much needed information for decision making by the salmon industry. Because future demand for and supply of farmed salmon are expected to increase simultaneously, the future price movement of farmed salmon is unclear. In this paper, a simultaneous equation model is estimated for the demand and supply of Norwegian Atlantic salmon in the U.S. and EC. Future supplies and prices of Norwegian Atlantic salmon in the U.S. and EC are the endogneous variables in the econometric model. The econometric model has nine exogenous variables including the total production of Norwegian Atlantic salmon, exchange rates, incomes, and price indexes. Future values of these exogenous variables are either assumed or estimated using time series

models. The econometric model is then solved using the future values of the exogenous variables for the future prices and supply of Norwegian Atlantic salmon in the U.S. and EC. It is important to note that the forecasted supply and prices are conditional on the values of the exogenous variables. Therefore, the accuracy of the forecasted prices and supplies can be improved if better predictions of the exogenous variables can be provided.

ENDNOTES

1. Monthly share of total supply within a year over the sample period is used to derive monthly supply from projected annual production for the forecast period. Supply to the U.S. and the EC is found to be approximately 75% of total Norwegian production during the sample period. This ratio is maintained for the forecast period.

Table 1. Forecasted Values of Exogenous Variables: 1989:1 to 1991:4.

	STOT (1000lb)	Y_{us} (billion)	Y_{ec} (billion)	PS_{us} (ECU/lb)	WPI_{us} (%)	WPI_{ec} (%)
1989:1	32,286	3,597	3,725	2.41	279.7	160.9
1989:2	35,639	3,664	3,775	2.21	280.5	163.0
1989:3	32,138	3,733	3,825	1.37	283.1	165.0
1989:4	48,749	3,804	3,875	1.14	283.3	167.1
1990:1	35,873	3,875	3,925	2.41	284.3	169.3
1990:2	39,599	3,948	3,975	2.21	285.0	171.5
1990:3	35,709	4,022	4,025	1.37	287.7	173.7
1990:4	54,166	4,098	4,075	1.14	287.9	176.0
1991:1	39,460	4,175	4,125	2.41	288.8	178.2
1991:2	43,559	4,254	4,175	2.21	289.5	180.5
1991:3	39,280	4,334	4,225	1.37	292.2	182.8
1991:4	59,582	4,416	4,275	1.14	292.4	185.2

Table 2. Supply and Price of Norwegian Atlantic Salmon

	US		EC	
	Supply (1000 lb)	FOB Price ($/lb)	Supply (1000 lb)	FOB Price (ECU/lb)
1989:1	16,038	2.85	16,248	2.16
1989:2	15,978	2.87	19,661	2.23
1989:3	11,443	2.61	20,696	2.05
1989:4	19,960	2.63	28,789	1.97
1990:1	19,629	2.98	16,244	2.25
1990:2	19,716	2.99	19,883	2.32
1990:3	14,493	2.70	19,039	2.10
1990:4	25,003	2.72	29,163	2.03
1991:1	23,519	3.13	15,941	2.37
1991:2	23,824	3.13	19,735	2.42
1991:3	17,949	2.81	21,331	2.17
1991:4	30,613	2.84	28,970	2.11

Table 3. Norwegian Atlantic Salmon FOB Price: 1984-1987.

	U.S. ($/lbs.)	EC. (ECU/lbs.)
1982:1	3.22	2.75
1982:2	3.24	3.04
1982:3	3.00	3.14
1982:4	3.20	2.87
1983:1	3.17	3.08
1983:2	2.96	3.00
1983:3	2.88	3.09
1983:4	2.95	3.04
1984:1	2.81	2.86
1984:2	2.91	3.20
1984:3	2.86	3.35
1984:4	2.88	3.38
1985:1	2.81	3.44
1985:2	3.15	3.90
1985:3	3.03	3.38
1985:4	3.25	3.37
1986:1	3.33	3.16
1986:2	2.77	2.58
1986:3	2.51	2.28
1986:4	2.69	2.28
1987:1	2.96	2.20
1987:2	3.68	2.87
1987:3	3.85	3.04
1987:4	3.94	2.99

REFERENCES

Bjorndal, Trond. Personal Communication.

Canada, Statistics Canada. Trade of Canada: Exports by Commodities. Ottawa: Canadian Bureau of Statistics, various issues.

Dart J., February 5, 1988. Windjammer Seafoods, Seattle Washington. Personal communication.

Gordon, B.G. The Outlook For Salmon And Shrimp Aquaculture Products In World Markets. National Marine Fisheries service. NOAA. Washington, D.C., 1985.

Herrmann, Mark and B.H. Lin. "The Demand and Supply of Norwegian Atlantic Salmon in the United SAtates and the Europian Community.: Presented at the fourth meeting of the IIFET conference, Esberg, Denmark. Aug. 7-11, 1988.

International Monetary Fund. International Financial Statistics. Washington D.C., various issues.

Norwegian Central Bureau of Statistics. "Norwegian Atlantic Salmon Export Data." Oslo, Norway.

Organization for Economic Corporation and Development. Main Economic Indicators. Department of Economics and Statistics, various issues.

Rogness, R.V. and B.H. Lin. The Marketing Relationship between Pacific and Pen-Raised Salmon: A Survey of U.S. Seafood Wholesalers. Alaska Sea Grant Report 86-2. Fairbanks, Alaska, September 1986.

Shaw, S.A. and J.F. Muir. Salmon: Economics and Marketing. Timer Press, Portland, Oregon, 1987.

U.S. Department of Commerce. Fishery Market News. NOAA, NMFS, Seattle, Washington, various issues.

U.S. Department of Commerce. World Salmon Aquaculture, 1986-1987. NOAA, NMFS. International Affairs, Foreign Fisheries Analysis Branch. October 30, 1987. Draft.

U.S. Department of Commerce. Survey of Current Business. Washington, D.C., various issues.

U.S. Department of Commerce. U.S. Exports for Consumption. Bureau of Census, Washington D.C., various issues. U.S.