Effects of Farmed Salmon on Wild Salmon Prices

Key Points

- ✔ The most important factor driving change in world salmon prices has been rapid and sustained growth in world farmed salmon and salmon trout production. This has fundamentally transformed world salmon markets—not only because of the dramatic growth in total supply, but also because of the changes that it has represented in the kinds of salmon products which are available, the timing of production, market quality standards and organization of the industry.
- ✔ Different wild salmon species and markets have been affected in different ways by farmed salmon. Generalizations about effects of farmed salmon on "wild" salmon prices risk being overly simplistic and misleading.
- ✔ During the 1990s the rapid growth of farmed salmon supply depressed prices not only for farmed salmon but also in most traditional wild salmon markets.
- ✔ More recently, prices for farmed and wild salmon have stabilized or increased. Wholesale price trends for farmed and wild salmon appear less closely correlated, suggesting that differentiation is occurring in markets for wild and farmed salmon. Some wild salmon products sell for lower prices than farmed salmon, while others command price premiums.
- ✔ Many other factors besides farmed salmon have also affected wild salmon prices. These include:
  - Increasing concentration in the retail and food service industries
  - Increased world pink and chum salmon harvests
  - Following the collapse of the Soviet Union, the emergence of Russian wild salmon as a significant competitor to North American wild salmon in the Japanese frozen market and world canned salmon and salmon roe markets
  - Declining consumer demand for canned salmon
  - The end of the Japanese "bubble" economy of the 1980s and a stubborn economic recession in Japan, historically the most valuable market for North American fresh and frozen wild salmon

Introduction

Since 1988, when prices hit historic highs, there have been dramatic changes in markets for wild salmon. Between 1988 and 2002, these changes were reflected in declining prices for most wild salmon products and declining prices paid to wild salmon fishermen. Figure XIII-1 shows prices paid to Alaska salmon fishermen expressed as a percentage of average real (inflation-adjusted) prices paid over the period 1980-2005. In 2002, prices were less than half of the average for this period for all species except chinook (which accounts for less than two percent of the Alaska catch volume).

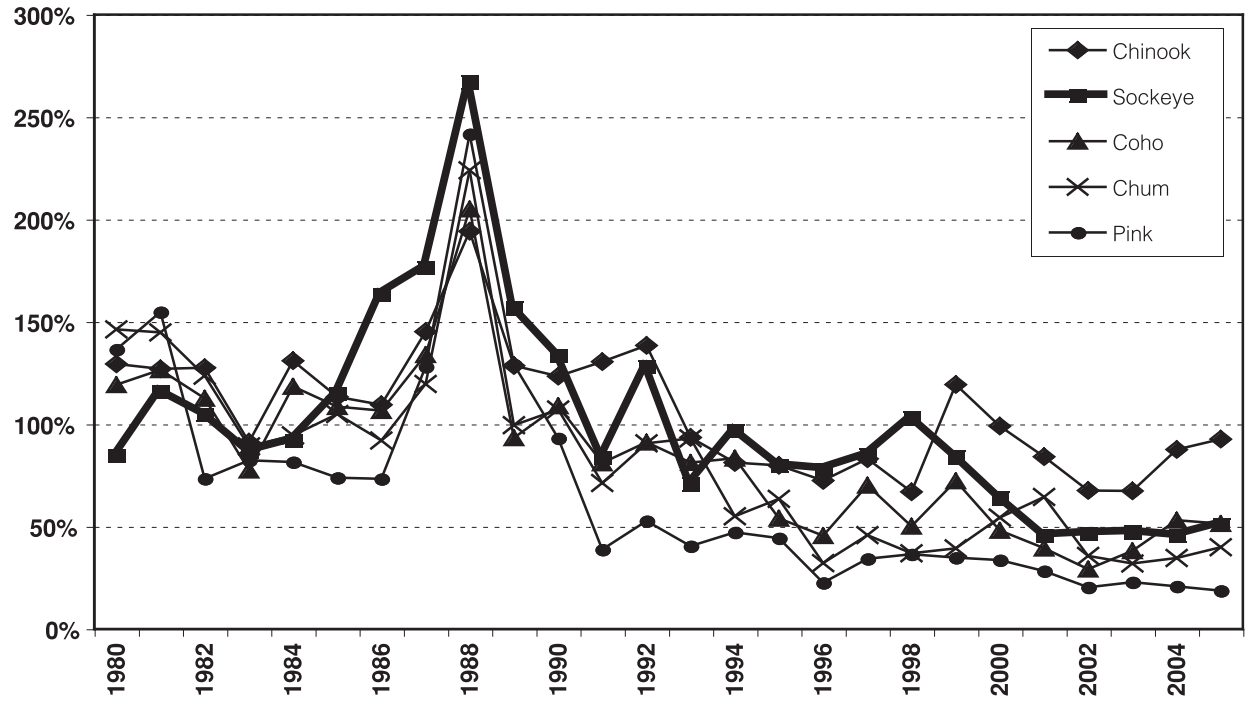
Between 2002 and 2005 real prices recovered, to varying extents, for all species except pink salmon. Prices increased significantly for chinook salmon and coho salmon (which together account for less than seven percent of the Alaska salmon catch volume). Prices increased much more modestly for sockeye and chum salmon.

In this chapter we examine the causes of these changes in wild salmon prices, and in particular the effects of farmed salmon on wild salmon prices. We begin with a brief overview of economic theory of how farmed salmon affects wild salmon markets. We next discuss challenges in quantifying the specific impacts of farmed salmon on wild salmon prices. We then briefly review available evidence about the effects of salmon farming and other factors on prices of wild salmon.

Throughout this discussion, it is important to keep in mind that the causes of changes in wild salmon prices,

and the effects of farmed salmon, vary for different wild salmon species. It is difficult to quantify the specific effects of farmed salmon on wild salmon prices, as many other factors have also affected prices.

Figure XIII-1 **Real Alaska Ex-Vessel Prices as a Percentage of Average for 1980-2005**



Source: CFEC Alaska Salmon Summary Data 1980-2005. Adjusted for inflation based on Anchorage CPI.

Overview—Economic Theory of Effects of Farmed Salmon on Wild Salmon Prices

Salmon markets are complex. To introduce this complex topic we begin by discussing price formation in a market with only wild salmon—before the introduction of farmed salmon.

Figure XIII-2 is a simplified representation of price formation in a market with only wild salmon. Numerous different factors together simultaneously determine prices at different market levels—ex-vessel, wholesale, and retail. Ultimately, prices at all levels of the market chain are driven by factors affecting both supply (shown in *italics* on the left side of the diagram) and demand (shown in *italics* at the top of the diagram).

Raw product supply is driven by fishing costs, environmental factors such as decadal ocean changes and effects of drought on spawning streams, hatchery production, natural wild salmon stocks, fisheries management programs and fishermen's preseason expectations about ex-vessel prices.

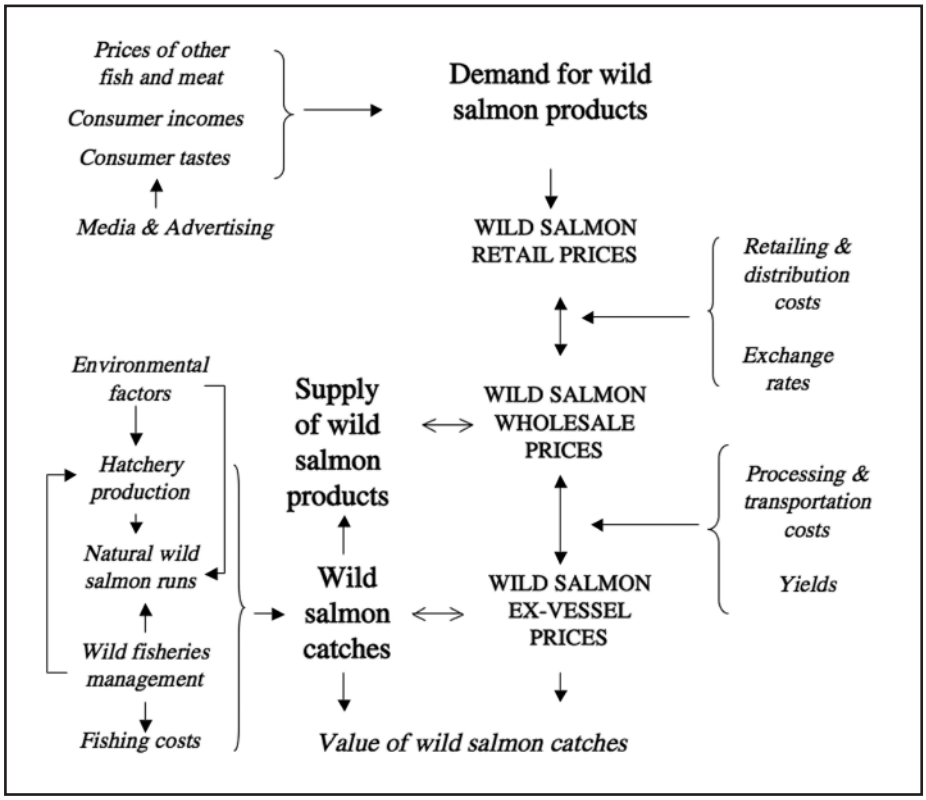
Final product demand is driven by consumer tastes, consumer incomes, prices of salmon and prices of substitute species of fish and meat. Media and advertising, such as positive media reporting on the healthful benefits of eating salmon or negative media on endangered salmon, influence consumer tastes and preferences.

Costs and the relative market power of different players in the market determine the relationships between prices at the ex-vessel, wholesale and retail level.

At any given time, many different factors are affecting prices and there are many different potential reasons why prices may change. For example, all of the following could contribute to a decrease in wild salmon prices:

- An increase in catches due to favorable environmental factors, such as favorable ocean conditions (by increasing supply)
- An increase in hatchery production (by increasing supply)
- A decrease in the price of beef (by lowering demand for salmon)
- An increase in retail labor costs (by increasing the margin between retail prices and wholesale prices)

Figure XIII-2 **Price Formation in a Market with only Wild Salmon**



Wild salmon ex-vessel prices (the prices paid to fishermen) are driven mainly by wild salmon wholesale prices. The difference or "margin" between wholesale prices and ex-vessel prices depends upon the costs of processing and transporting fish, as well as the extent of competition for fish among the processors fishermen sell to and more generally the relative market power of fishermen and processors. This margin is relatively more stable than wholesale or ex-vessel prices. This means that when wholesale prices rise or fall, ex-vessel prices tend to rise or fall by a similar absolute (dollar) amount.[1]

If margins are relatively stable in absolute (dollar) terms, then changes in the factors which affect prices—such as fish catches or consumer demand—tend to have a greater relative or percentage effect on ex-vessel prices than on wholesale prices. To see why this is so, consider a simple example in which the wholesale price falls from $3.00 to $2.00, or by 33 percent (Table XIII-1). If the margin between the wholesale price and the ex-vessel price stays at $1.00, the ex-vessel price falls from $2.00 to $1.00, or by 50 percent.[2]

This example shows why ex-vessel prices are likely to be relatively more sensitive to changes in market conditions than wholesale or retail prices (and helps to explain why prices paid to wild salmon fishermen have been so significantly affected by salmon farming). Ex-

Table XIII-1 **Relative Effects of a Change in Market Conditions on Wholesale and Ex-Vessel Prices: A Simple Example**

	Year 1	Year 2	Change	% Change
Wholesale price	$3.00	$2.00	- $1.00	-33%
Margin	$1.00	$1.00	no change	
Ex-vessel price	$2.00	$1.00	- $1.00	-50%

[1] This may be seen in the graphs of wholesale and ex-vessel prices for Alaska salmon shown in Chapter VII (Figures VII-9, VII-10, and VII-11).

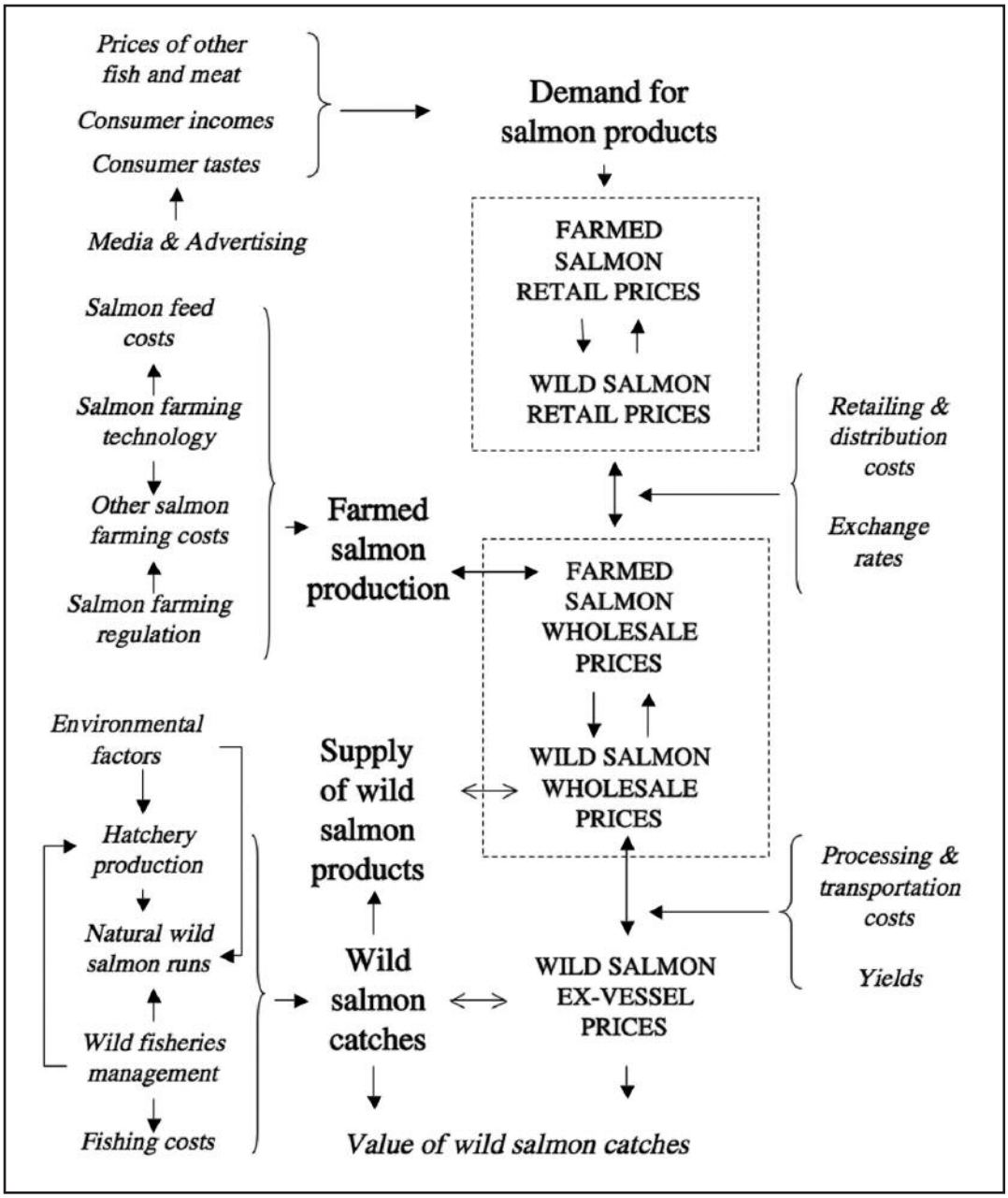
[2] For purposes of this simple illustration, Table XIII-1 assumes a constant margin. Actual margins are not constant, and tend to increase when wholesale prices increase. However, as long as margins change by a smaller percentage than wholesale prices—as is typically the case—ex-vessel prices will change by a greater percentage than wholesale prices.

vessel prices received by wild salmon fishermen are much lower than retail or wholesale prices, after deducting the significant costs of processing, distribution and retailing. As a result, when retail or wholesale prices decline, fishermen experience a much greater proportional decline in the prices they are paid.

Salmon farming has significantly increased the complexity of salmon markets. Figure XIII-3 is a simplified representation of price formation in a market with both farmed and wild salmon. This figure keeps all the factors which affect prices in Figure XIII-2, while adding new factors related to salmon farming.

There are several important points to be drawn from this figure. First, prices of farmed and wild salmon affect each other at both the wholesale and retail levels. To varying degrees, farmed and wild salmon are substitutes; meaning that buyers will switch between wild and farmed salmon depending upon the relative prices of each. Thus, to some extent, prices of wild and farmed salmon will track one another. If farmed salmon prices rise, buyers are willing to pay more for wild salmon. If farmed salmon prices fall, buyers are not willing to pay as much for wild salmon.

Figure XIII-3 **Price Formation in a Market with Farmed and Wild Salmon**



How closely prices of wild and farmed salmon are linked depends upon the extent to which buyers view them as substitutes, which in turn depends on the physical characteristics of the fish, the product form and the extent to which buyers care about the origin of the fish or whether they are farmed or wild. This will likely vary depending on the species of wild salmon. In addition, the extent to which particular wild salmon species and farmed salmon are substitutes may change over time if buyers' knowledge of and relative preferences for wild and farmed salmon change over time.

How buyers perceive the relative quality of farmed and wild salmon affects the relative price levels that they command in the market. If buyers perceive that a particular wild salmon product is superior to farmed salmon, then that wild product may command a price premium over farmed salmon. If buyers perceive that a wild salmon product is inferior to farmed salmon, that product's prices may be discounted relative to farmed salmon prices.

What matters are not only perceptions of consumers. Perceptions also matter of wholesale buyers—retail and food service operators—who consider not just taste but also reliability of supply, consistency of sized, shelf-life and other factors which affect their costs.

The introduction of farmed salmon also changes the dynamics of salmon markets—how supply and prices change over time. In a market with only wild salmon, short-term changes in prices are driven primarily by natural fluctuations in wild catches, while longer-term trends in prices are driven primarily by changes in demand. If wild catches are low in a particular year, prices rise and if wild catches are high, prices fall, all else held constant. Thus the financial effect on fishermen of a low catch is partially offset by higher prices.

In a market with only one type of salmon (e.g. wild), year to year there tends to be an inverse relationship between wild salmon catches and wild salmon prices. Longer-term (multi-year) trends in average prices are driven primarily by longer-term trends in catches, as well as changes in consumer demand.

With the introduction of salmon farming, these market dynamics change in several important ways. First, as farmed production becomes an ever-larger share of total supply, wild salmon prices are driven more and more by farmed salmon supply rather than by wild salmon supply as wild salmon becomes a smaller player in the market. This results in a weaker inverse relationship between wild salmon catches and prices—which means that wild salmon fishermen can no longer count on a low catch being offset in part or in full by higher prices. The inverse relationship between wild catch and prices still exists—but it is muted by the larger market.

Another way in which the introduction of farming changes the dynamics of salmon markets results from the ability of salmon farmers to adjust production in response to changes in expected profits.[3] If farmers expect to make profits, they have an incentive to expand production. If farmers expect to lose money in the future, they have an incentive to reduce production.

Either decision involves risks, because it takes many months for a fish to reach market size, by which time conditions in the market may have changed. If farmers expect prices to rise and expand production they risk losing money if prices do not rise. If farmers expect lower prices and reduce production they risk being left short of product to sell if prices rise.

If farming is at first highly profitable, this tends to result in rapid expansion of farmed production—resulting in declining prices—until profits fall to a "normal" level. If demand were constant and costs were constant, production would eventually stabilize when prices fell to the level at which farmers no longer had any financial incentive to expand production. However, if costs of production decline, prices can continue to decline by a similar amount, allowing production to continue to expand (but more gradually) over time, while prices continue to fall (but more gradually).

If farmers are overly optimistic about future prices, they may produce so much salmon that prices are driven below costs of production—causing salmon farmers to lose money. Subsequently, in reaction to losing money, farmers may cut back on production so much that prices rise well above costs of production.

These periods of over-production followed by cutbacks in production may lead to price cycles for farmed salmon, with periods of very low prices followed by periods of higher prices—similar to the price cycles which occur for beef and pork. These price cycles—driven by the farmed salmon industry—will in turn affect wild salmon prices.

Other Effects of Farmed Salmon on Wild Salmon Markets

The effects of farmed salmon on wild salmon markets go far beyond those resulting from an increase in total supply. Farmed salmon has profoundly changed almost every part of the salmon business. Almost every part of the fresh and frozen salmon industry—including distribution, retail and food-service—has shifted its orientation from wild salmon to farmed salmon. Before farmed salmon, the industry was oriented towards distributing and selling a limited range of salmon products, of widely varying quality, which were available only seasonally in limited, varying and

[3] Hatcheries have the same capability.

uncertain quantities from relatively small producers. Now the salmon industry is oriented towards distributing a much wider range of salmon products, of much more consistent quality, in much larger volumes, from much larger producers. Wild salmon has become a smaller, specialized part of a much larger salmon business, involving special challenges but also special opportunities.

Farmed salmon has increased quality standards for salmon in world markets. Most farmed salmon is a visually appealing product of consistent quality. Given a choice, buyers and consumers are less willing to purchase wild salmon unless it is equally attractive and of equally consistent quality.

Farmed salmon has changed the timing of market demand for salmon. Formerly salmon was a seasonal product: fresh salmon was available only during (primarily) summer salmon runs. Now fresh farmed salmon is available year-round, and suppliers of wild fresh salmon face a marketing disadvantage because they cannot meet the needs of those retail and foodservice buyers who wish to offer consumers the same products year-round.

The farmed salmon industry has developed new salmon products and raised buyer and consumer expectations for product convenience. One important example is the development of pinbone-out fillets, which now represent a major, and increasing, share of the U.S. salmon market. With pinbone-out fresh farmed salmon fillets now widely available, consumers are less likely to choose less convenient wild salmon product forms with bones.

Farmed salmon changes consumers' perceptions of what "salmon" tastes like. As more and more consumers eat farmed salmon, the more likely they are to consider the taste of farmed salmon to be what salmon "should" taste like. They may come to consider that wild salmon tastes less like "salmon" than farmed salmon.

Farmed salmon has greatly expanded the availability of salmon, especially in the mid-West and East. As total supply and the reliability of supply has increased, farmed salmon is now commonly available year-round in U.S. restaurants and retail stores which formerly carried salmon only seasonally, if at all.

Over time, as the supply and availability of farmed salmon has increased, demand has also increased. As consumers who may have never eaten salmon or eaten it only rarely try it—perhaps because it is on sale or a new option on a restaurant menu or a friend serves it to them—they are more likely to purchase it in the future.

Increasing demand has allowed the farmed salmon industry to continue to grow. World markets now absorb far more salmon than they could have a decade ago. This growth in demand represents an opportunity for wild salmon. In a much bigger market, there are new opportunities for those wild salmon producers who can take advantage of the potential competitive advantages of wild salmon—ranging from costs of production to taste, appearance and other characteristics of wild salmon.

Over the past few years, concerns of some consumers about health and environmental issues associated with farmed salmon have emerged as another potential competitive advantage of wild salmon, and contributed to a steep rise in prices paid for some kinds of high-quality wild salmon (such as troll-caught chinook salmon) in some markets.

Other Factors Affecting Wild Salmon Prices

As discussed earlier, salmon markets are complex, and many different factors affect salmon prices. It is clear that many other factors in addition to farmed salmon have affected wild salmon prices in recent years—although it is difficult to quantify their effects.

After farmed salmon, one of the most important factors affecting salmon prices has likely been globalization of world food markets. Loosely defined, "globalization" includes a wide variety of changes in the world economy, including technological revolutions in communications and transportation; increasing reliance on markets (as opposed to government controls); reductions in trade barriers; greater world economic integration in markets for resources, goods, services, labor and capital; shifts in production from higher-cost to lower-cost producers; consolidation and integration resulting in larger, more powerful firms operating in many countries; growing consumer incomes in developed and developing countries; and increasing consumer expectations for quality, convenience, variety and lower prices.

Globalization is transforming seafood processing, distribution and retailing. Changes in the seafood industry associated with globalization include rapid expansion of seafood trade; increasing consolidation and market power in the retail and food service industry; restructuring of seafood distribution networks; increasing pressure on seafood suppliers to lower costs, internationalization of standards for food handling and safety and a shift in labor-intensive seafood processing to countries with low labor costs.

One important effect of globalization is that relatively few large retail and foodservice buyers are dominating more and more of the seafood market—including the salmon market—in the United States, Europe and Japan. These buyers want consistent and reliable supply of large volumes of seafood at low, stable and competitive prices. In general, farmed salmon meets

the needs of these buyers better than wild salmon. As a result, the trend towards concentration in the retail and food service industries tends both to stimulate growth in the farmed salmon industry, and also to exacerbate the effects of farmed salmon on wild salmon markets.

More generally, salmon, like other food and non-food products, is increasingly being sold in a global market, in which all sources of supply directly or indirectly affect all markets. This represents both an opportunity for North American wild salmon producers (who have historically benefited from selling to export markets) but also a threat (from growing competition from other salmon suppliers in both domestic and foreign markets).

Changing wild salmon supply conditions have affected wild salmon prices, and are likely to continue to do so in the future. Important changes in wild salmon supply conditions that have occurred over roughly the same time period as the dramatic expansion of farmed salmon supply include:

- Increased world pink salmon harvests (partly from North American and Russian hatcheries) and canned pink salmon production
- Increased world chum salmon harvests, primarily due to North American and Japanese hatchery production
- Following the collapse of the Soviet Union, the emergence of Russian wild salmon as a significant competitor to North American wild salmon in the Japanese frozen market (Russian sockeye) and world canned salmon and salmon roe markets (Russian pink and chum salmon)

Changes in consumer demand have also affected wild salmon prices. Some of these have resulted from the rapid expansion of farmed salmon supply and the development of new salmon product forms. Others include:

- Declining consumer demand for canned salmon with the development of other more convenient and attractive product forms, including frozen, fresh and MRE (meals ready to eat), and the aging of traditional canned salmon consumers. Recall that "declining demand" does not necessarily mean declining sales. Rather, it means a decline in the volume that consumers are willing to purchase at any given price. In other words, it means that any given volume can only be sold for a lower price. As was discussed in Chapter VIII, the fact that given volumes of canned pink and canned sockeye salmon command lower wholesale prices than formerly strongly suggests that canned salmon demand is declining (or, more technically, the demand curve for canned salmon is shifting inward).
- Declining Japanese consumer demand for certain traditional salmon roe products, in particular sujiko.
- The end of the Japanese "bubble" economy of the 1980s and a stubborn economic recession in Japan, historically the most valuable market for North American fresh and frozen wild salmon.

All of these factors suggest that the market challenges faced by North American wild salmon producers go well beyond competition from farmed salmon. Thus, even if salmon had never been farmed, the wild salmon industry would likely have experienced challenges and change in recent years.

Challenges in Quantifying the Effects of Farmed Salmon on Wild Salmon Prices

Above, we have briefly reviewed economic theory of how we would expect farmed salmon to affect wild salmon prices. However, for a number of reasons, it is very difficult to quantify the specific effects of farmed salmon on specific wild salmon prices over time. Put differently, it is difficult to say how much of a change over time in the price of a particular wild salmon product, or the price paid to a fisherman for a given wild salmon species, was caused by farmed salmon.

The challenges in quantifying the effects of farmed salmon on wild salmon prices result from the variety and complexity of salmon markets, as well as the rapidity of changes that have occurred in these markets. There is not a single "salmon market," but rather many different markets for many different products and many different species in many different countries which are all linked, to varying degrees, in the international salmon market system. At any given time, many different factors are affecting these different markets in many different ways. And all of these markets are experiencing rapid changes not only as a result of salmon farming but also because of rapid changes in the world economy and the global food industry.

To quantify how market factors affect each other, economists usually use statistical techniques known as "econometrics," which examine how variations in different variables (such as wild salmon catches, farmed salmon production, exchange rates and prices) have been related to each other over time. However, there are several significant challenges in using econometrics to study salmon markets.

First, the more complex a market is, and the more factors that affect it, the more data are required for an econometric analysis of the relationship between different variables. But many of the kinds of data needed for econometric analyses of salmon markets simply do not exist. For example, no data are available for the volume of

[4] Recall that the estimates presented earlier in this report were derived by subtracting reported U.S. exports from the sum of reported domestic production and imports, and can only be considered approximations of actual supply.

wild salmon entering the U.S. fresh and frozen market.[4] Similarly, no consistent data series are available for U.S. retail prices for wild salmon of different species and product forms. This makes it very difficult to estimate empirically the effects of wild salmon supply on wild salmon retail prices in the U.S. market.

Second, salmon markets have been changing rapidly. The mix of fresh and frozen products available today varies from those of a decade ago. Distribution channels and market structure have changed, as have costs of transportation and distribution. The kinds of stores and restaurants where salmon is sold have changed. As total supply has expanded, new kinds of consumers are eating salmon. What consumers know about wild and farmed salmon has changed. Because of these and other changes, farmed salmon does not necessarily affect wild salmon markets in the same way today as it did a decade ago. With these continuing changes, historical data may not provide reliable information about current salmon market relationships.

Some changes that may have affected salmon markets have occurred only recently—such as extensive publicity about health and environmental issues associated with farmed and wild salmon. Not enough time has passed to measure how long-lasting the effects of this publicity may be and whether any permanent changes in market relationships may have occurred.

Third, many of the factors affecting salmon markets have been changing over time in a similar way—continually increasing or decreasing from year to year rather than varying from year to year in different ways. For example, farmed salmon supply has been increasing during the same period of time that retail and food service industries have been becoming more concentrated. Theoretically, we would expect both of these changes to put downward pressure on salmon prices. But because they have both been changing in similar ways over time, it is difficult to distinguish statistically between the relative effects each is having on prices.

For all of these reasons, econometric modeling of salmon markets is difficult. Although various economists have attempted econometric analyses of certain salmon markets, there has been insufficient research to quantify how much of the changes in wild salmon prices in recent years can be attributed specifically to farmed salmon.

Comparison of Price Trends for Farmed and Wild Salmon

One way to gain insights into the effects of farmed salmon on wild salmon markets is by comparing price trends for farmed and wild salmon. As discussed above, the relative prices commanded by farmed and wild salmon provide an indicator of how buyers perceive the relative quality of farmed and wild salmon, while the extent to which farmed and wild prices tend to move together provides an indicator of the extent to which they are perceived as substitutes and how directly they compete with each other in different markets.[5] In this section we briefly compare wholesale prices of farmed salmon with wholesale prices of wild chum and chinook salmon in the U.S. market, and with wholesale prices of wild sockeye salmon in the Japanese market.

Wild chum salmon is generally considered a relatively lower quality fish than chinook, coho and sockeye salmon, and generally commands lower ex-vessel, wholesale and retail prices than these other wild species. Most chum salmon is sold in retail stores as whole, fillet, steak and value-added products, rather than in restaurants.

Since the 1990s, wild chum salmon has accounted for between one-third and one-half of the fresh and frozen wild salmon sold in the U.S. market (Figure XIII-4). As U.S. farmed salmon consumption has grown, the share of wild chum salmon in U.S. fresh and frozen salmon consumption has declined over time. During the period 2000-2004, wild chum salmon accounted for only about nine percent of U.S. fresh and frozen consumption, and Americans consumed about nine times as much farmed salmon as wild chum salmon.

Figure XIII-5 compares trends in wholesale prices for farmed Atlantic and wild chum salmon in the U.S. market.[6] Over the entire period from 1991 to 2006, fresh and frozen chum salmon sold at significantly lower wholesale prices than fresh farmed whole Atlantic salmon and Atlantic salmon fillets. Clearly, U.S. wholesale buyers view fresh and frozen wild chum salmon as a lower quality product than fresh farmed Atlantic salmon.

Farmed Atlantic and wild chum prices exhibit similar long-run (multi-year) trends over time—suggesting that they are substitutes to some extent and compete in some market segments. Prices for both Atlantic and chum salmon trended downward between 1991 and 1996 and upwards between 1996 and 1999.

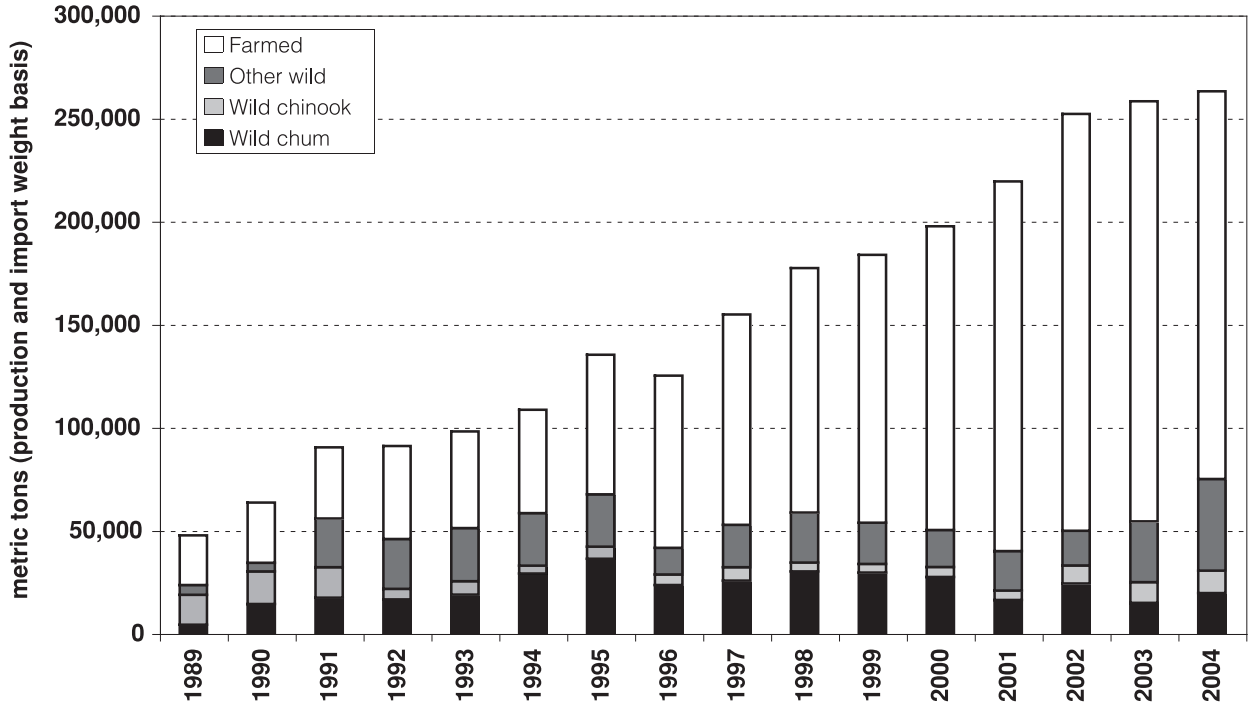
In general, it appears that U.S. farmed salmon wholesale prices limit the prices buyers are willing to pay for wild chum salmon. However, other factors, such as the supply of chum salmon, also affect chum prices and the extent to which buyers "discount" chum salmon prices compared with farmed Atlantic salmon.

In contrast to chum salmon, chinook salmon—particularly troll-caught chinook—are considered a

[5] Other factors besides substitutability can contribute to similar price movements over time. For example, imposing the same tax on two products may make their prices change in the same way, even if they are not substitutes. However, if prices move closely together over time, both up and down, this strongly suggests that they are substitutes.

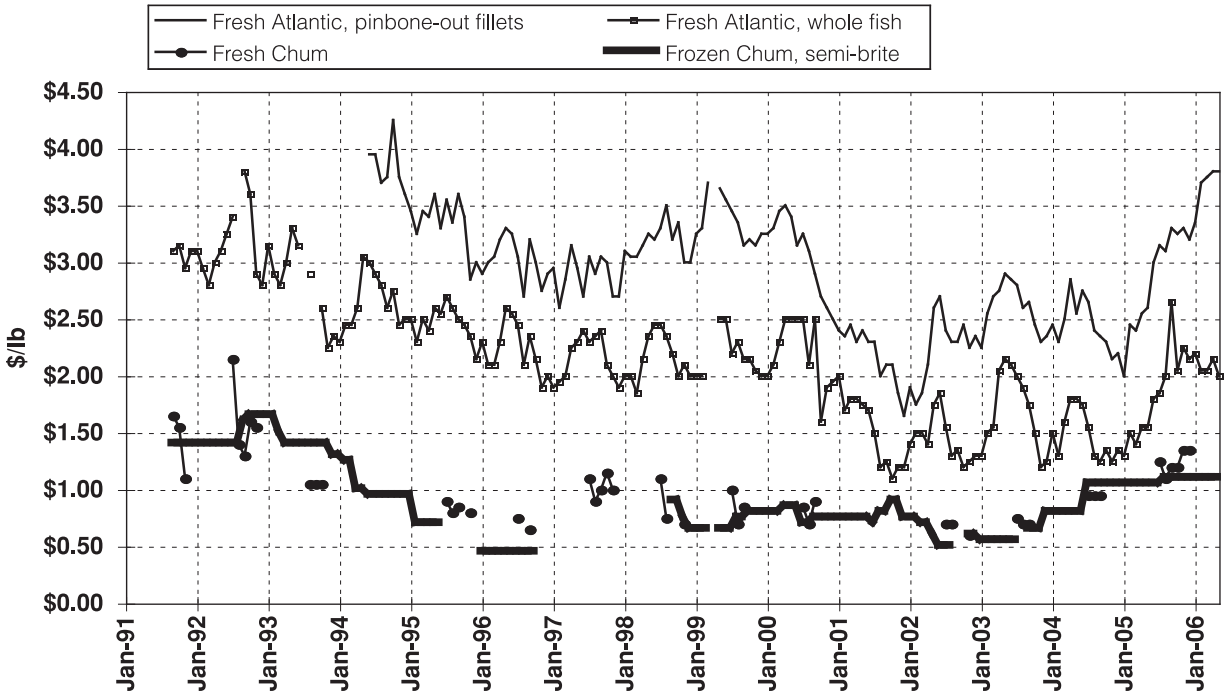
[6] This figure was presented earlier in Chapter VI.

Figure XIII-4 **Estimated United States Fresh and Frozen Salmon Consumption: Wild Chum, Wild Chinook, Other Wild, and Farmed**



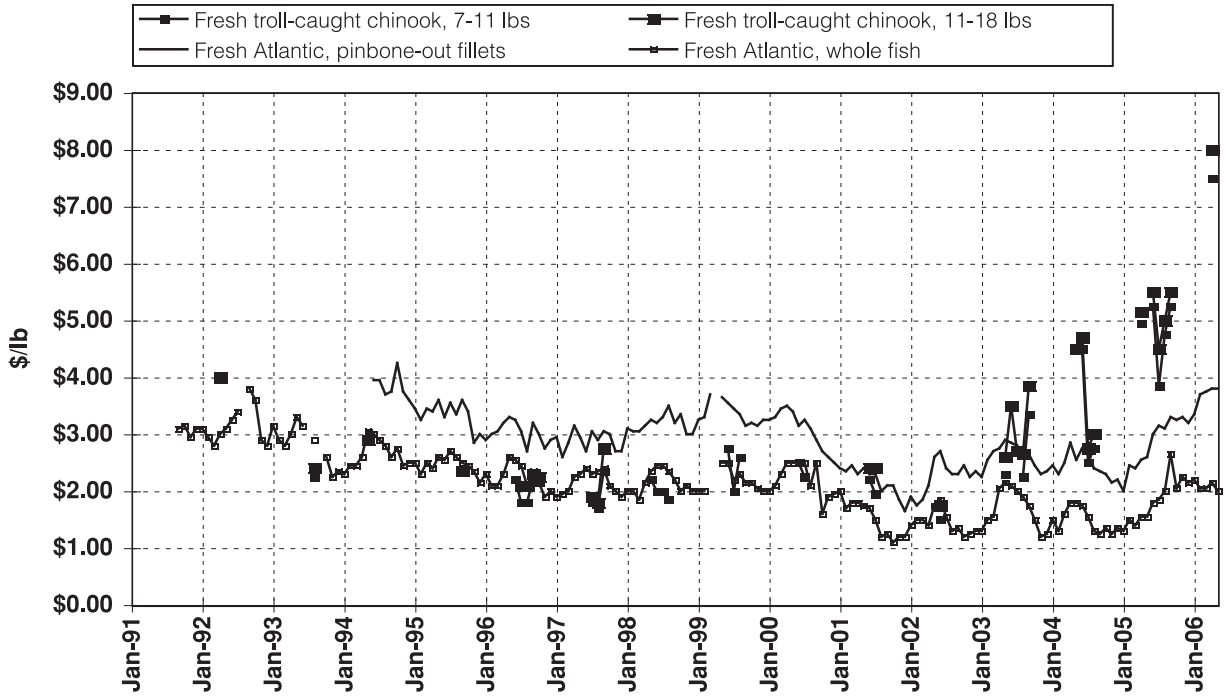
Source: Estimated using the United States Salmon Market Database described in Appendix C.

Figure XIII-5 **U.S. Wholesale Prices for Selected Salmon Products: Farmed Atlantic and Wild Chum**



Source: Urner Barry Wholesale Price Data reported in Urner Barry Publications, Inc., Seafood Price Current. Prices are low list prices for the first issue of the month for Chilean 2-3 lb fillets, premium scale-on, pinbone-out, FOB Miami Chilean C-trim Atlantic fresh fillets; 6-8 lb whole Atlantics, FOB Northeast; 4-6 lb gillnet head-off fresh chum, FOB Seattle; 6-9 lb H&G semi-brite frozen chum, FOB Seattle.

Figure XIII-6 **U.S. Wholesale Prices for Selected Salmon Products: Farmed Atlantic and Wild Chinook**



Source: Urner Barry Wholesale Price Data reported in Urner Barry Publications, Inc., Seafood Price Current. Prices are low list prices for Chilean 2-3 lb fillets, FOB Miami; 6-8 lb Atlantics, FOB Northeast; and 7-11 lb and 11-18 lb troll-caught head-on chinook salmon.

very high quality wild salmon, and a large share are sold to restaurants. However, chinook salmon represent only a small share of U.S. salmon supply. During the period 2000-2004, wild chinook salmon accounted for only about three percent of U.S. fresh and frozen consumption, and Americans consumed more than twenty times as much farmed salmon as wild chinook salmon.

Figure XIII-6 compares wholesale prices of farmed Atlantic and wild troll-caught chinook salmon.[7] During the 1990s wild chinook salmon commanded similar prices to fresh whole Atlantic salmon, and exhibited similar long-term and short-term changes in prices—suggesting that U.S. wholesale buyers considered them relatively close substitutes and that they competed in similar markets.

However, since 2003, prices of wild troll-caught chinook have risen steeply to more than double the prices paid for fresh whole Atlantic salmon. This suggests that several factors which have occurred since 2003, including wild salmon marketing efforts, negative publicity about farmed salmon, and growth in total market demand all may have played a role in allowing wild troll caught salmon to command this price premium.

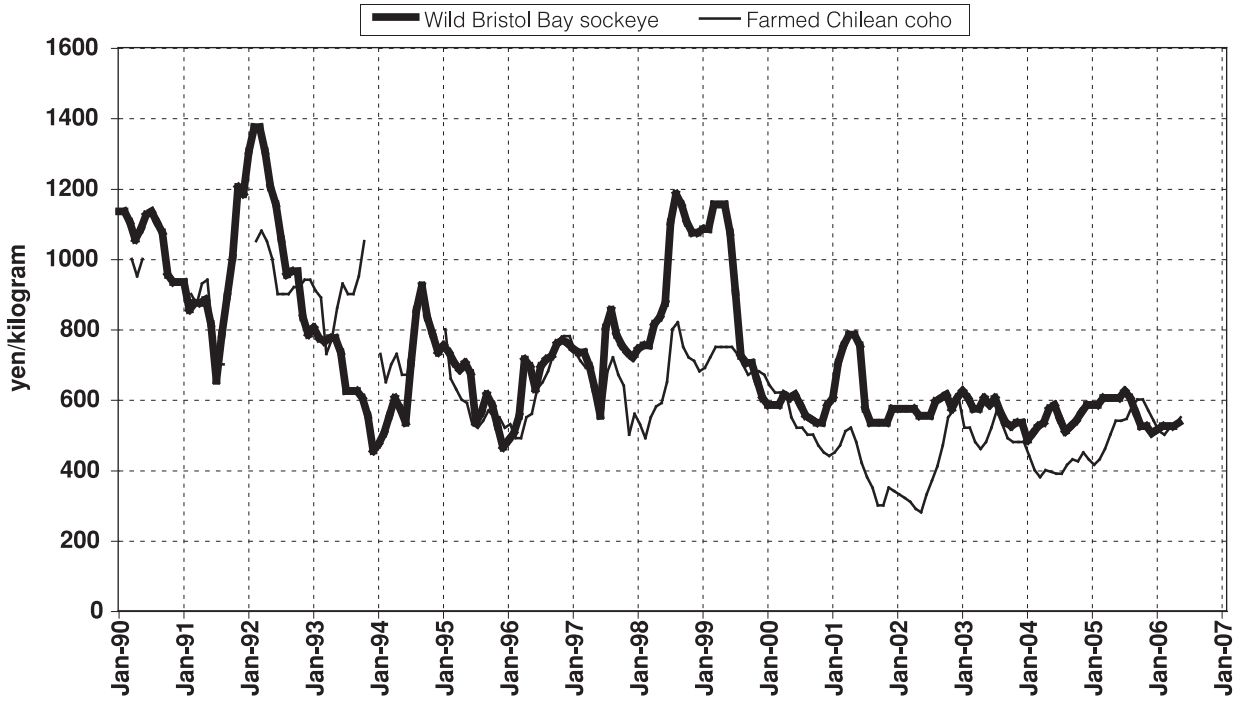
As discussed in Chapter VI, frozen sockeye salmon competes in the Japanese market with other frozen "red-fleshed" salmon, particularly farmed Chilean coho and farmed Chilean and Norwegian salmon trout. During the 1990s, as farmed imports grew rapidly and sockeye production declined, the sockeye share of the Japanese red-fleshed salmon market declined dramatically. Increasingly, sockeye salmon is being sold to specialized regional and product markets which specifically prefer sockeye salmon, rather than competing directly with farmed coho and trout in high-volume retail markets.

As shown in Figure XIII-7, Japanese wholesale prices of frozen wild Bristol Bay sockeye salmon and frozen farmed Chilean coho salmon tended to move together relatively closely prior to 1998. Since 1998, however, prices of farmed coho have several times fallen significantly below prices of wild sockeye during periods of low sockeye production or high coho production.

In general, prior to the introduction of farmed salmon, wild salmon was sold in a limited number of traditional markets—defined as a particular product sold to a particular kind of consumer in a particular kind of store or restaurant in a particular region. As farmed salmon was introduced, it competed initially

[7] The scales are different for Figures VIII-4 and VIII-5, because troll-caught fresh chinook salmon commands much higher prices than gillnet-caught fresh and frozen chum salmon.

Figure XIII-7 **Japanese Wholesale Prices of Selected Frozen Salmon Products, 1990-2006**



Source: Prices are from the Seafood News Power Data Book 2002 edition for months prior to May 2002. Beginning May 2002, prices are from FIS Japan Frozen Wholesale Prices data. Prices are low list prices for 4-6 lb fish, No. 1 grade.

with wild salmon in some traditional markets—depressing wild salmon prices in those markets—and also developed new markets.

As farmed salmon supply has continued to expand, the total market has continued to grow and diversify. Salmon is now being sold in more product forms, to more kinds of consumers, in more kinds of stores and restaurants and in more regions in more countries. The limited supply of wild salmon, representing a smaller share of the market, is being sold increasingly in particular market segments where it can compete most effectively with farmed salmon. Some of these are higher-end niche markets, such as the high-quality restaurants and fish stores where most troll-caught fresh chinook salmon are sold, and command high prices from buyers willing to pay a premium for high-quality wild salmon. Others are lower-end markets, such as supermarket fish counters where fresh and frozen chum salmon provide an economical salmon choice. As premium (highly differentiated) wild salmon competes less directly with farmed salmon, wholesale buyers of wild salmon for niche markets are less directly influenced by the wholesale prices being paid for farmed salmon.

Relative Magnitude of Effects of Farmed Salmon on Different Markets

The relative growth in farmed, wild and total salmon supply has differed widely between different major world markets. As shown in Table XIII-2, comparing average annual supply for the periods 1990-94 and 2000-04, total supply to the U.S. fresh and frozen market increased by 170 percent. In contrast, total supply to the Japanese fresh and frozen market increased by only 11 percent.[8]

The relative contribution of farmed salmon and trout to total supply also varies widely between markets. During the period 2000-04, farmed salmon and trout accounted for 96 percent of estimated consumption for the EU fresh and frozen market, 80 percent of the U.S. fresh and frozen market and 49 percent of the Japanese fresh and frozen market.

Given the rapid growth of farmed salmon supply to the U.S., European Union and Japanese fresh and frozen markets, and the high share of farmed salmon in total supply to each of these markets by the end of this period, it seems reasonable to expect that growth in farmed salmon supply would have had a negative effect on wild salmon prices in all three of these markets.

[8] Note also that the 184 percent increase in farmed salmon and trout supply to the canned market is deceptive since the absolute numbers are very small.

Table XIII-2 **Changes in Salmon Supply to Major World Markets, 1990-94 average to 2000-04 average**

	Type of salmon	Total world supply	Consuming Markets (processed weight basis)				
			United States fresh & frozen markets	EU fresh & frozen markets	Japanese fresh & frozen markets	Canned salmon markets	Other markets
Percent change, 1990-94 to 2000-04	North American wild salmon	-16%	4%	0%	-70%	-14%	148%
	Japanese & Russian wild salmon	16%			-10%	16%	16%
	Farmed salmon & trout	267%	350%	164%	227%	184%	327%
	TOTAL	83%	170%	149%	11%	-23%	188%
Estimated share of total in 2000-04	North American wild salmon	17%	20%	4%	8%	84%	15%
	Japanese & Russian wild salmon	20%	0%	0%	42%	13%	40%
	Farmed salmon & trout	63%	80%	96%	49%	3%	46%
	TOTAL	100%	100%	100%	100%	100%	100%

Note: Based on estimates presented in Chapter VI. Because they depend on numerous assumption, these estimates should be considered only approximate. Totals may not add to 100% due to rounding.

In contrast, given the very small contribution of farmed salmon to world canned salmon supply, farmed salmon probably had very small direct effects on canned salmon prices prior to 2000-04. Nevertheless, canned markets may have been indirectly affected by farmed salmon. By depressing markets for fresh and frozen salmon, farmed salmon may have caused wild salmon producers to can a relatively larger share of wild catches, leading to greater supply of canned salmon and lower canned salmon prices than would otherwise have occurred.[9]

Changes in Salmon Market Dynamics

As discussed earlier, as wild salmon becomes a smaller share of world salmon supply, we would expect to see a less direct inverse relationship between wild salmon supply and wild salmon prices. For example, in the 1980s and early 1990s, when wild Alaska sockeye harvests dominated total supply of "red-fleshed" salmon to the Japanese market, prices paid to Alaska sockeye fishermen tended to be lower when catches were high, and higher when catches were low (Figure XIII-8).[10] After the late 1990s, when sockeye was a much smaller share of Japanese supply, the inverse relationship between catches and prices was weaker.

However, there continued to be an inverse relationship between the total Japanese supply of "red-fleshed" frozen salmon and average annual Japanese wholesale prices for wild sockeye salmon (Figure XIII-9).[11] As total imports increased during the 1990s, sockeye prices fell; as total imports leveled off after 2000-01, sockeye prices stabilized.

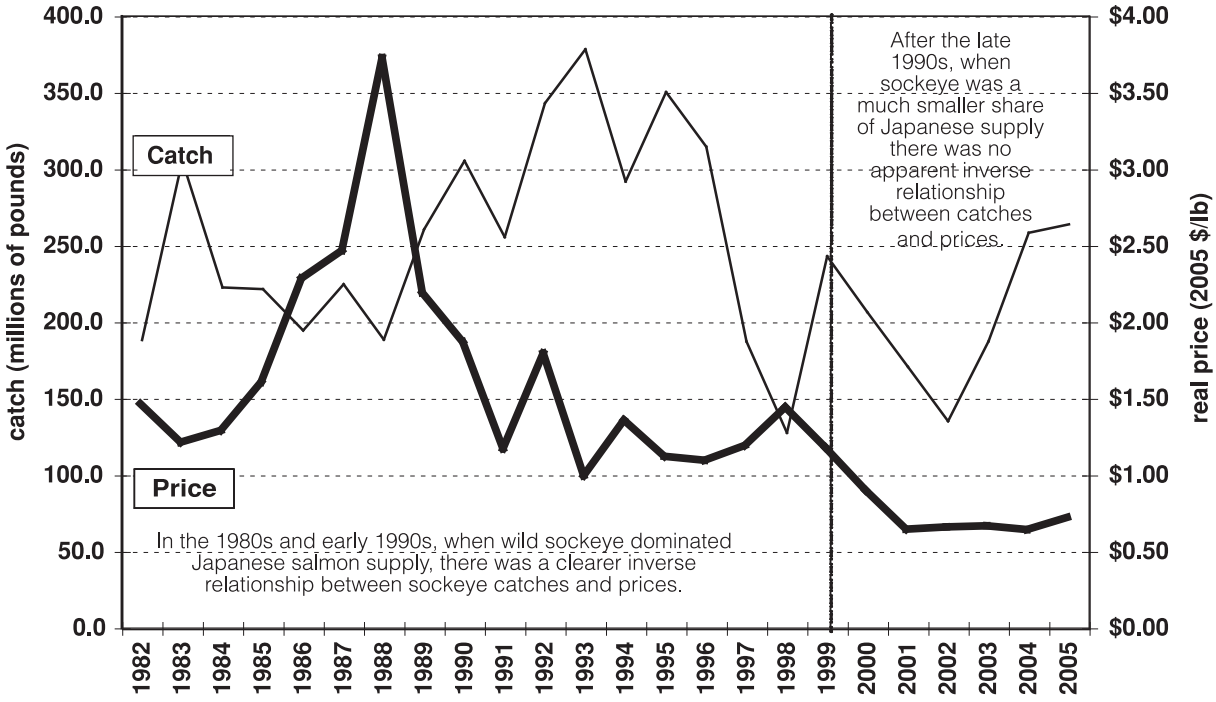
The fall in sockeye prices during the 1990s, which seems inconsistent with the decline in sockeye catches and Japanese wild sockeye imports, is consistent with the dramatic increase in total Japanese supply which occurred during the same time period. It is what we would expect if sockeye prices were being driven not only by sockeye supply but also by total supply—both farmed and wild.

9 In 2003 Chile began to produce significant volumes of canned salmon. Thus, farmed production may be gaining importance as a factor in canned salmon markets.

10 Note that we would not expect to see a perfect inverse relationship. Numerous factors other than catches also influence prices, such as inventories and exchange rates.

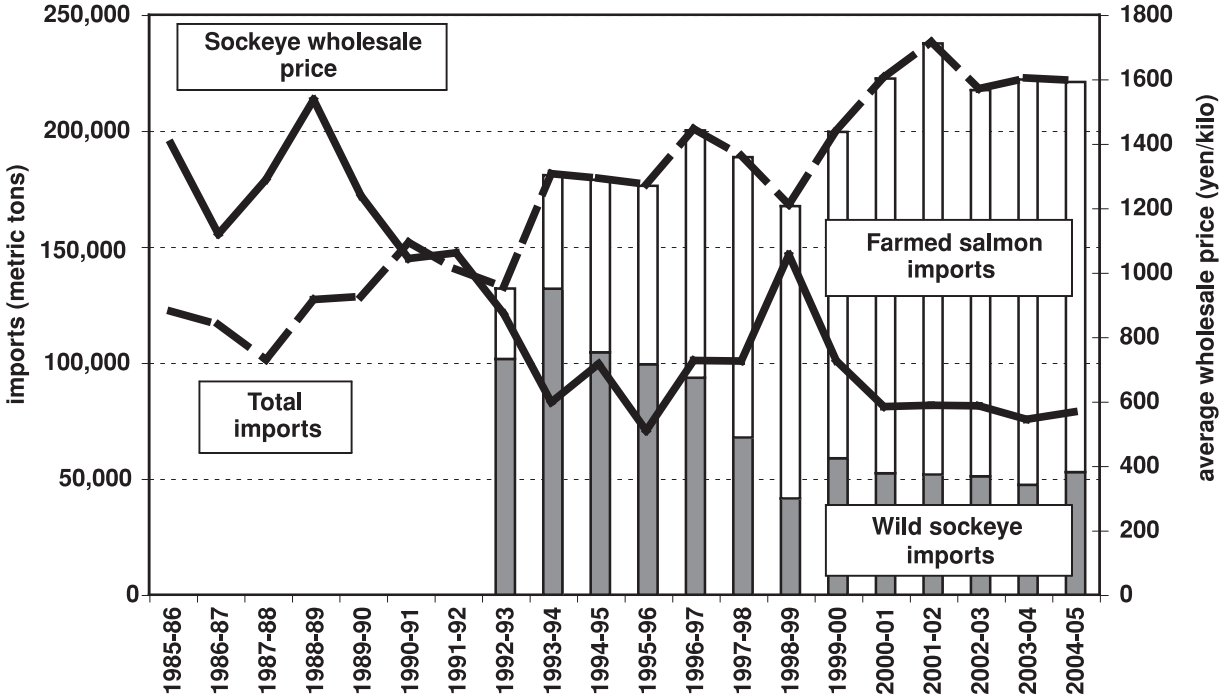
11 "Red-fleshed" frozen salmon imports include frozen sockeye, coho and trout. In Figure XIII-9, both average prices and annual imports are measured for the "salmon year" of May-April.

Figure XIII-8 **Alaska Sockeye Salmon Catch and Real Ex-Vessel Price, 1982-2005**



Source: CFEC Alaska Salmon Summary Data 1980-2005. Ex-vessel price adjusted for inflation based on Anchorage CPI.

Figure XIII-9 **Japanese "Red-Fleshed" Frozen Salmon Imports & Wild Sockeye Wholesale Price**



Source: All data are reported on a "salmon-year" basis (May-April). Wild sockeye imports and farmed salmon imports were calculated from monthly BANR Japanese Salmon Import Data. Total imports for years prior to 1992-93 (when sockeye salmon import data were not reported) were calculated from Japan Tariff Association Salmon Trade Data. Sockeye wholesale price is annual (May-April) unweighted average of monthly sockeye prices from the following sources: 6/91-1/97: data reported in Bill Atkinson's News Report; beginning 2/97: FIS Japan Frozen Wholesale Prices Data, low end of price range for 4-6 lb sockeye.

Effects of Catch Volume on Wild Salmon Catch Value

What matters to wild salmon fishermen is not just the price they receive, but also the volume of fish they catch, both of which together affect the value of what they catch.

The economic difficulties of the wild salmon industry are commonly blamed on lower prices, and by implication on farmed salmon. For all species, lower prices have been the most important cause of the loss in value. However, this is not the whole story. To varying degrees for each species, changes in catches—which were not caused by farmed salmon—have magnified or reduced the effects of changes in prices on the value of wild salmon catches.

The top half of Table XIII-3 shows average price, catch and value for each Alaska salmon species for the period 1986-90 and for the years 2002 and 2005. The bottom half of the table shows percentage changes in price, catch and value between these three periods.

Between 1986-90 and 2002, prices declined sharply for all species. For chinook and sockeye salmon, catches also declined (by 22 percent and 42 percent, respectively)—magnifying the decline in value. In contrast, for coho, pink and chum salmon, catches increased—offsetting the decline in value to varying extents.

Between 2002 and 2005, prices increased for all species except pink salmon. For chinook, sockeye and pink salmon, catches also increased—magnifying the rebound in value for chinook and sockeye salmon. For pink salmon, the percentage increase in catches exceeded the percentage decrease in price, causing the catch value to rise. In contrast, catches declined for coho and chum salmon. For chum salmon, the percentage decrease in catch exceeded the percentage increase in price, causing the catch value to fall.

Table XIII-3 **Percentage Changes in Price, Catch and Value of Alaska Wild Salmon: 1986-90 to 2002 and 2002 to 2005**

		Chinook	Sockeye	Coho	Pink	Chum	Total
1986-90 avg.	Price (2005 $/lb)	$3.09	$2.50	$1.75	$0.69	$0.79	
	Catch (millions of lbs)	12	235	36	240	85	
	Value (millions of 2005 $)	$36.20	$566.83	$62.11	$156.60	$71.84	$893.58
2002	Price (2005 $/lb)	$1.49	$0.65	$0.39	$0.11	$0.22	
	Catch (millions of lbs)	9	135	39	301	139	
	Value (millions of 2005 $)	$13.71	$88.27	$15.30	$31.89	$30.42	$179.59
2005	Price (2005 $/lb)	$2.05	$0.71	$0.69	$0.10	$0.24	
	Catch (millions of lbs)	10	264	32	543	95	
	Value (millions of 2005 $)	$21.28	$188.50	$21.86	$52.80	$23.15	$307.58
Change, 1986-90 avg. to 2002	% change in price	-52%	-74%	-77%	-85%	-72%	
	% change in catch	-22%	-42%	8%	25%	64%	
	% change in value	-62%	-84%	-75%	-80%	-58%	-80%
Change, 2002 to 2005	% change in price	37%	9%	76%	-8%	12%	
	% change in volume	13%	95%	-19%	81%	-32%	
	% change in value	55%	114%	43%	66%	-24%	71%
Change, 1986-90 avg. to 2005	% change in price	-34%	-71%	-60%	-86%	-69%	
	% change in volume	-11%	12%	-13%	127%	12%	
	% change in value	-41%	-67%	-65%	-66%	-68%	-66%

Source: CFEC Alaska Salmon Summary Data 1980-2005.