Changes in the Japanese seafood market
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Anthony Kingston, Tony Battaglene, Perry Smith and Stephen Beare

Project 9323.101
Foreword

Japan is well established as the main export market for Australian seafood, and the profitability of many sectors of the Australian fishing industry depends on strong export demand from Japan.

Food consumption patterns in Japan are changing. Meat consumption has grown strongly in recent years, and this trend is expected to strengthen following the removal of beef import quotas in 1991. There has also been a dramatic increase in seafood supplies available in Japan. The spectacular growth in Asian aquaculture production in recent years has greatly increased supplies of prawns to the Japanese market and has caused prawn prices to fall dramatically. To counter this, some sectors of the Australian prawn industry have suggested a promotional campaign to increase demand — and subsequently prices — for Australian prawns.

A major finding in this study is that any increase in beef consumption in Japan is unlikely to have a major impact on the demand for seafood. It is also found that the decline in household consumption of seafood is likely to continue, that this trend can be expected to strengthen with any further increases in household income, and that a promotional campaign designed to increase demand for Australian banana prawns is unlikely to be successful given the nature of Japanese demand for crustaceans.

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In the past twenty years, Japan has moved from being the world’s largest exporter to the largest single importer of fisheries products. Seafood products now account for the largest single component of Japanese food imports. This reversal in trading position can be attributed to a number of factors, including decreased domestic supplies resulting from stock depletion and the introduction of exclusive economic zones, a strengthening of domestic demand for some high valued, mainly imported, fisheries products, and the declining competitiveness of Japanese fisheries products on export markets due to the appreciation of the yen.

Changes in diet

The dietary patterns of the Japanese people have also changed. Consumption of meat and seafood has increased, from around 33 kg per person (product weight) in 1960 to almost 63 kg in 1987, while consumption of carbohydrates, particularly rice, has fallen steadily. Increased exposure to Western culture, strong growth in real wages and the dramatic strengthening of the yen are all likely to have contributed to these changes in consumption. The recent rapid increase in seafood supplies — especially prawns — stemming from the growth in Asian aquaculture production, and the easing of Japanese beef import restrictions in the 1990s are two other factors likely to have a substantial impact on future food consumption patterns in Japan.

Importance of the Japanese market

Japan is the most important export market for Australian seafood, and any change in Japanese seafood demand will have important implications
for the Australian seafood industry. In 1988-89, Australia exported nearly $340 million of seafood products to Japan, representing around 60 per cent of Australia’s seafood export earnings.

Modelling demand

Most recent studies of the Japanese food market have focused on the demand for meat — beef, pork and chicken — with little emphasis given to seafood. Although there have been studies of the responsiveness of Japanese seafood demand to changes in price, a wide range of results have been reported. And the relationships between seafood and other food commodities have been difficult to estimate.

The purpose in this study is to identify the importance of, and estimate the magnitude of, the price and non-price relationships that are likely to influence Japanese seafood demand. Of particular concern is the effect of any increase in beef consumption on seafood demand. A demand system approach, with three seafood categories (crustaceans, tuna and other fish) and three meat categories (beef, pork and chicken), is used to estimate the importance of factors such as price, income and age of the consumer on consumption. The relationships between the three seafood categories analysed and between seafood and the other meat groups can be investigated using this method.

Results

The growth in total Japanese meat and seafood consumption experienced in recent years is likely to continue. However, household consumption is expected to fall, and the implication of this is that consumption in the away from home market is likely to grow. These developments should strengthen the demand for Australian seafood because most Australian seafood is consumed in the away from home market.

Aggregate demand for seafood was found to be relatively unresponsive to changes in seafood prices. The implication of this is that non-price factors,
such as tradition, are an important influence on the level of seafood consumption. These non-price factors seem most important in the away from home market.

In contrast, the demand for individual seafood commodities, especially crustaceans, was found to be responsive to changes in price and there appears to be strong competition among the different seafood commodities. Price is an important factor in determining the type of seafood that is consumed, particularly at the household level.

Japanese demand for beef was found to be responsive to changes in price, and any fall in retail beef prices following the removal of import quotas is likely to lead to strong growth in beef consumption. Only a weak substitution relationship was found between beef and seafood, which means that the demand for seafood may be largely unaffected in the short term by changes in beef prices. The demand for pork is likely to be the most adversely affected by any increase in beef consumption.

Lifestyle factors were found to be having a negative effect on the level of household consumption. Using cohort analysis, and keeping price and income constant, it was found that the decline in household seafood consumption by the younger age groups is likely to continue over time, and that this will intensify as young consumers move into the older age categories.

Conclusion

In recent years the growth in Asian aquaculture production has resulted in lower prawn prices on export markets, including Japan, causing the Australian banana prawn industry financial difficulties. For example, during the 1989 season, prices for Australian banana prawns fell dramatically.

Promotion of Australian banana prawns on the Japanese market has been suggested as one way of improving industry profitability by increasing the demand for the Australian product. However, the
results of this analysis indicate that prices are extremely important in determining the type of seafood consumed in the home and that household prawn consumption is highly responsive to changes in price. In addition, changes in Japanese lifestyle are altering demand patterns and are influencing consumers to reduce household food consumption, particularly of crustaceans. One such lifestyle change is that a higher proportion of Japanese women are remaining in the workforce, which has led to increased consumption of food away from home and strengthened demand for convenience foods.

It may be difficult to persuade consumers to pay a premium for the Australian product given the degree of price responsiveness of demand for crustaceans and the competition between seafoods at the household level. There may, however, be some scope to increase demand for Australian banana prawns by changing current marketing practices, such as by improving grading and packaging.
Australian seafood exports to Japan

Despite the vast size of the Australian fishing zone, the waters in the zone are generally low in nutrients and cannot support large stocks of fish. As a result, Australia is not a large seafood producer by world standards. Production is concentrated on a few high value commodities — rock lobster, prawns and abalone — and these three commodities account for over 90 per cent of Australian seafood export returns.

The value of Australian seafood exports to Japan grew strongly in the 1980s, increasing from $158 million in 1981-82 to almost $340 million in 1988-89, while the quantity exported remained reasonably stable at around 20 kt. There were, however, changes in the composition of seafood exported, with a marked decrease in the quantity of prawns being offset by increased exports of rock lobster and a range of other seafood products (figure A).

The factor most responsible for the increase in the real prices received for Australia’s seafood exports to Japan was the movement in exchange rates. In 1981-82 one Australian dollar was worth 248 Japanese yen; six years later one Australian dollar could buy only 97 yen. This change in the relative value of the two currencies was caused by both a strengthening of the yen and a weakening of the Australian dollar. A stronger yen increases demand in Japan for all imported foods, as the price of these goods fall in yen terms. In contrast, a weaker Australian dollar lowers the price of Australian goods sold in Japan, which should increase the demand for Australian products.

Because of the currency movements the average wholesale price of Australian

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**Australian seafood exports to Japan**

<table>
<thead>
<tr>
<th>Year</th>
<th>Prawns</th>
<th>Abalone</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982-83</td>
<td>15</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1984-85</td>
<td>10</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1986-87</td>
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<tr>
<td>1988-89</td>
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**Value of Australian seafood exports to Japan**

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual</th>
<th>Adjusted</th>
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</thead>
<tbody>
<tr>
<td>1984-85</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>1985-86</td>
<td></td>
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<tr>
<td>1987-88</td>
<td></td>
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<tr>
<td>1988-89</td>
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</tr>
</tbody>
</table>

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Japanese seafood market
seafood in Japanese yen in real terms was less in 1988-89 than it was in 1982-83 (Monaghan 1989).

The movements in exchange rates have also effectively increased the returns in Australian dollars to Australian seafood exporters. This can be seen in figure B, where export returns altered only slightly when the exchange rate against the yen is kept constant at the 1984-85 level ($A1 = ¥193), compared with the actual situation where the nominal value of Australian seafood exports increased over the middle to late 1980s.

Composition of Australian seafood exports to Japan

Japan accounted for around 60 per cent of Australia's seafood export revenue in 1988-89 and is firmly established as the major export market for Australian seafood. However, Australia's share of the Japanese market is relatively minor, with the value of imports from Australia representing less than 5 per cent of Japan's total seafood imports.

The composition of Australian exports to Japan in 1988-89 in value terms is shown in figure C. Australian exports are concentrated around three products — prawns (45 per cent), rock lobster (24 per cent) and abalone (also 24 per cent). The remaining 7 per cent consists of a variety of products including tuna, other fish and sea urchin roe.

**Prawns**

Australia produces around 20 kt of prawns a year, a level which, allowing for seasonal fluctuations, has not altered greatly in the past decade.

In 1988-89 Australia exported 8.3 kt of prawns valued at $152 million to Japan.

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**Japanese prawn imports from major suppliers**

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taiwan</td>
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<tr>
<td>Thailand</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Indonesia</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>India</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td></td>
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</tbody>
</table>

This represented about 30 per cent of total Australian seafood export revenue in that year but only 5 per cent of the value of Japanese prawn imports, compared with almost 10 per cent in the early 1980s.

The largest influence on the Japanese prawn market in recent times has been the boom in world aquaculture production. Japanese imports of farmed prawns were 118 kt in 1989, about 45 per cent of total prawn imports. The major suppliers to the Japanese market are shown in figure D (Battaglene and Kingston 1990).

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**Composition of Australian seafood exports to Japan in 1988-89**

<table>
<thead>
<tr>
<th>Product</th>
<th>Quantity (kt)</th>
<th>Value ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prawns</td>
<td>8.3</td>
<td>152,000</td>
</tr>
<tr>
<td>Rock lobster</td>
<td>2.0</td>
<td>83,000</td>
</tr>
<tr>
<td>Abalone</td>
<td></td>
<td>80,000</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>23,000</td>
</tr>
</tbody>
</table>
Australian prawn exports to Japan consist mainly of tiger and banana prawns, with small quantities of western king prawns also exported. Australian brown tiger prawns are a high value product, sold mainly through restaurants. They are similar in colour and form to the highly prized Japanese ‘karuma’ prawn and consequently receive a higher market price than either the farmed black tiger prawns from Asia or banana prawns. Australian tiger prawns are generally sold whole and their large size and bright red colour after cooking make them a desirable ingredient in the preparation of sushi.

Australian banana prawns are sold mainly as a headless product through supermarkets and other retail outlets for household consumption. Japanese consumers are probably unable to differentiate between Australian banana prawns and the farmed white prawns from Indonesia and China on the basis of appearance or packaging. Relative prices are likely to be the dominant factor when consumers decide which prawns to buy, so the high costs of fishing in Australia compared with the production costs of prawn farming make it very difficult for Australian banana prawns to be price competitive with the farmed white prawns from South-East Asia (Battaglene and Kingston 1990).

The situation has been aggravated from an Australian perspective by the increasing number of farmed black tiger prawns appearing on supermarket shelves; the Australian banana prawn now has to also compete on a price basis with this popular species.

Rock lobster
It was only in the mid-1970s that Japan became an important export market for rock lobster. Australia is now one of the main suppliers of rock lobster to Japan, with Australian exports increasing from 1.2 kt ($11.3 million) in 1981-82 to 3.9 kt ($83 million) in 1988-89. Australia’s major competitors on the Japanese market are Cuba, India and South Africa. Japan has a small domestic rock lobster fishery with an annual production of about 1 kt.

Australia has a comparative advantage over many of its competitors on the Japanese lobster market because of the similarity in appearance between the western rock lobster and Japan’s domestically caught lobster.

The export market for Australian rock lobster has changed considerably since the early 1980s (figure E). In 1981-82, 84 per cent of rock lobster export revenue was derived from the United States, while only 12 per cent came from Japan. Throughout the 1980s Japan increased in importance as an export market for Australian rock lobster. By 1988-89, Japan generated 43 per cent of rock lobster export receipts. In 1988-89, the importance of the Japanese market was further emphasised as exports to the

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**Value of Australian rock lobster exports to major markets**

<table>
<thead>
<tr>
<th>Year</th>
<th>Japan</th>
<th>United States</th>
<th>Taiwan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982-83</td>
<td>150</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>1984-85</td>
<td>100</td>
<td>100</td>
<td>50</td>
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<td>100</td>
</tr>
<tr>
<td>1988-89</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

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*Japanese seafood market*
United States declined markedly, relegating the US market to second position with 34 per cent. Sales to the emerging Taiwanese market represented 16 per cent of total Australian rock lobster exports in 1988-89.

Originally most rock lobster imported by Japan was in whole frozen form. However, in recent years, demand for live lobster has increased significantly, growing from 7 per cent of total lobster imports in 1985 to 16 per cent in 1987. Australia is a leading supplier of live rock lobster to Japan, accounting for 27 per cent of the market in 1989.

Monaghan (1989) estimated that 90 per cent of live and frozen raw lobster imports into Japan are consumed in restaurants and 75 per cent of the boiled western rock lobster imports are consumed at functions. Live, boiled and fresh rock lobster are also sold through department stores.

Japanese lobster consumption is highest during the wedding seasons of April–May and September–October, when the lobster is a traditional dish with high symbolic significance. To be served at these functions, the lobster must be undamaged, with no missing legs or feelers, and be bright red in colour.

There may be potential to increase supplies to the Japanese market in future years. Monaghan (1989) has forecast that increased demand for lobster in Japan may lead to growth in the boiled lobster market of 10 per cent and the live lobster market of 20 per cent each year over the next ten years.

**Abalone**

In 1988-89 Japan took 85 per cent of Australian exports of fresh, frozen and chilled abalone and 52 per cent of canned abalone exports. Abalone exports to Japan in 1988-89 were valued at $80 million, representing about 14 per cent of total Australian seafood exports.

Australia holds major market shares of the Japanese abalone market for both frozen and canned abalone. In 1988-89 Australia supplied 78 per cent of the frozen abalone imported by Japan and 98 per cent of all imports of canned abalone. The major suppliers of live, fresh or chilled abalone to Japan are China, which supplies around 50 per cent of the market, and Korea, which supplies a further 30 per cent. Australia supplied about 11 per cent of this sector of the market in 1989.

There has been a substantial reduction in Japanese imports of fresh, chilled or frozen abalone in recent years due to worldwide shortages of supply caused by overfishing. In Australia, catch quotas have been steadily reduced in response to biological concern about the stock, and production has fallen from around 7.7 kt in 1981-82 to 5.5 kt in 1988-89. Although the quantity has declined, the value of production has increased due to a fourfold increase in beach prices, from an average $3.40/kg in 1982-83 to $15.80/kg in 1988-89 (ABARE 1989).

During the 1980s Australian exports of canned abalone to Japan more than doubled, from 502 t in 1981-82 to 1165 t in 1988-89. It is estimated that about 40 000 cartons of canned abalone are distributed in Japan each year. Canned abalone is predominantly consumed through restaurants.

Abalone is considered a high value product on the Japanese market. Very little abalone is purchased for household consumption, with the majority being

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consumed in restaurants or given as presents. Presentation boxes containing an abalone, sauces and sometimes a little bottle of sake are a popular gift sold through department stores.

Exchanging gifts is an important part of Japanese culture and it is traditional to give gifts twice a year. This makes presentation boxes containing abalone an important outlet for the product.

**Other seafood products**

Exports of Australian tuna to Japan are relatively small but growing. Such exports were valued at around $8 million in 1988-89. The major tuna species exported from Australia to Japan is southern bluefin, with exports totalling 2.1 kt in 1989. Australia holds a relatively small share of the total Japanese tuna market.

Most tuna is consumed in the form of sashimi, with the preferred species being southern bluefin, bigeye and yellowfin. Southern bluefin tuna is used almost exclusively by the restaurant trade for sashimi, while about 50 per cent of bigeye is used in restaurants and 50 per cent as household sashimi. The majority of yellowfin tuna sashimi is consumed in households (Ashenden and Kitson 1987).

The Japanese market is very conservative about fish species demanded, with the domestic (Japanese) product commanding a price premium over foreign substitutes. Japanese consumers prefer fresh fish, which is being reflected in the marketplace with the increase in imports of live or chilled seafood. Imports of live/fresh seafood into Japan by air increased by 13 per cent in quantity in 1989 over 1988. In the Australian fishing industry there are specialist operators who airfreight chilled fish to Japan.

School whiting has been marketed successfully in Japan for a number of years. Australia exported 745 t of frozen school whiting to Japan in 1988-89, valued at $1.5 million.

Opportunities may exist for exporting a range of other speciality seafood products aimed at particular market niches in Japan. For example, in 1989 Japan imported 989 t of sea urchin roe. Australia’s contribution to this total was negligible, but some Australian exporters are processing sea urchin for this market.

A report into underutilised seafood species and export markets (Hassall and Associates Pty Ltd 1988) suggested that Australian species with the most market potential in Japan are high valued, probably chilled products which can be airfreighted and are assured of a consistent supply. Potential species suggested included yellowtail kingfish, spanner crab, scampi and garfish.

Octopus are common on several Australian fishing grounds and are often caught as a by-catch by trawlers or in lobster pots. Attempts have been made to exploit this resource in Western Australia, but uneconomic catch rates have thus far made such attempts unsuccessful (Hassall and Associates Pty Ltd 1988).

Another species being exported to Japan in small quantities with some success is the giant deep sea crab, which is caught as a by-catch by both trawl fishermen and cray fishermen in south-east Australian waters.
Changes in Japanese eating habits

Australian exports of seafood to Japan depend not only on Australian supply but on Japanese demand. The Japanese food market is changing and a number of new trends are emerging in Japanese consumption of meat and seafood. The nature of these changes are discussed in this chapter, and a number of factors that may be responsible for inducing these changes are outlined.

Consumption of meat and seafood

Since the 1960s fundamental changes have taken place in the dietary patterns of the Japanese people. The average caloric intake per person has grown from 2200 a day in 1960 to around 2600 in 1987 (Nakase 1990), with the composition of food intake changing considerably. Annual per person consumption of meat and seafood has almost doubled, from around 33 kg (product weight) in 1960 to 63 kg in 1987, while consumption of carbohydrates, predominantly rice, has fallen steadily — from 115 kg in 1960 to 88 kg in 1975 and 73 kg in 1987 (ABARE 1988).

Aggregate consumption of meat and seafood (in net food weight) per person was derived for the period 1965–88 to identify the changes that have taken place in Japanese consumption patterns (details of the data sources are outlined in appendix D). Over the 24 year period, Japanese consumption of meat per person increased by 6.5 per cent a year. Seafood consumption also grew but at a slower rate (1.5 per cent a year). As a result, meat’s share of aggregate meat and seafood consumption expanded over the period (figure F).
Within the meat sector the consumption of pork and chicken has risen much faster than that of beef, as shown in figure G. Consumption of seafood (fresh, chilled and frozen) has also risen, but at a slower rate (figure H).

**Household and away from home consumption**

Data from the annual reports of the Japanese Family Income and Expenditure Surveys (Statistics Bureau 1988a) were used to analyse household consumption behaviour. In contrast to the growth in meat and seafood consumption at the aggregate level, consumption at the household level has fallen slightly, as shown in figure I.

The trend in seafood consumption in Japanese households varies between different age groups in the population. In particular, the decline in seafood consumption is concentrated among the younger households (as defined by the age of the head of the household) — see figure J.

A similar trend was identified by Isibasi, Taya and Ono (1987) who analysed monthly household consumption and expenditure on various food items to estimate the influence of age, class and sex on food consumption. They found that there was a tendency for advanced age classes to have higher consumption of marine products. Kusakabe and Anderson (1989) reported similar results. Isibasi et al. found that the younger age groups consume more pork and chicken than do the other age groups, and that males consume more marine products than do females.

Any differences between consumption in the aggregate and household
sectors reflect consumption in the away from home market. Unfortunately, the data from the aggregate and household sectors are not comparable and, consequently, only broad conclusions can be drawn about away from home consumption. In the case of seafood, aggregate consumption is increasing at a time when household consumption is declining, and it can be assumed that the growth in seafood consumption is taking place in the away from home market.

Annual sales of the top 100 restaurant chains rose by 9 per cent in Japanese fiscal year 1988, the third consecutive year that the restaurant sector recorded a growth rate of that magnitude (Middaugh 1990). In addition, an increasing percentage of total family expenditure is being allocated to eating out and processed foods.

The trend toward more frequent eating out has also strengthened the demand for higher priced seafood. For example, the restaurant trade (comprising high class sashimi/sushi restaurants, most hotels and family restaurants) is reported to be the largest and most important single buyer of imported fresh farmed salmon (Japan Trade Development Division 1990). In the away from home sector, consumption of traditional oriental meals has declined, and consumption of Western foods has increased substantially.

Another finding from Kusakabe and Anderson (1989) was that the younger age groups allocate a higher percentage of their food expenditure to eating out and to precooked foods than do the older age groups. This trend was reinforced when single person households were included in the study, because there was a greater tendency for single people to spend a higher percentage of total food expenditure on eating out.

Influences on Japanese eating habits

A number of influences, such as changes in relative prices of food products, income growth, lifestyle factors and changes in food supplies, may be responsible for the observed changes in consumption patterns.

Price effects

Seafood and beef products have become more expensive relative to pork and chicken in Japan, and the change in market shares may partly reflect consumer reaction to these price movements. Changes in relative prices for the period 1965–88 using annual retail price data from the Ku area of Tokyo (Statistics Bureau 1988b) are shown in figure K.

Income effects

The increase in meat and seafood consumption may also result partly from the rising incomes of Japanese

<table>
<thead>
<tr>
<th>Indexed retail prices for meat and seafood in the Ku area of Tokyo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef</td>
</tr>
<tr>
<td>Pork</td>
</tr>
<tr>
<td>Seafood</td>
</tr>
<tr>
<td>Chicken</td>
</tr>
</tbody>
</table>

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consumers. Since 1960, personal consumption expenditure per person in Japan has risen at an average rate of around 11 per cent a year (International Monetary Fund 1988). The growth was most rapid during the 1970s when expenditure rose by an average 13 per cent a year. In the 1980s the rate slowed to around 4.5 per cent a year.

Gunthorpe (1990) suggests that rising incomes are an important element in the increasing consumption of red meat in Japan. And a Canadian report (Japan Trade Development Division 1990) has found that growth in personal disposable income in Japan has led to increased consumption of salmon and that, in general, Japanese consumers have shifted their preferences toward higher quality fish. Williams (1988) also suggests that rising incomes have strengthened Japanese demand for and thus consumption of the more expensive fish types such as salmon, prawns and tuna.

**Lifestyle changes**
Changes in lifestyle associated with an increasing ‘Westernisation’ of Japanese culture may also have influenced food demand.

Ohtagaki (1986) claims that an increasing proportion of the population is turning to a diet containing more convenience meals in preference to the traditional, but time consuming, fish and rice dishes. Cooking convenience is now an important consideration and a growing range of products are now available that are specially designed for quick and easy microwave preparation (JETRO 1987b).

The trend toward convenience seafoods has also resulted in a greater preference for fish which have a variety of uses (for example, main meal, school lunches, treats, snacks). The fall in the number of households with extended families and increase in the number of people living alone has meant that consumers prefer to buy food in smaller packages (JETRO 1987c).

Williams (1989) also suggests that there is an increasing trend to purchase seafood which is ready to eat or easy to prepare, resulting in a decrease of sales by traditional seafood shops and an increase in sales by supermarkets and department stores. It has been suggested that the increasing consumption of meat in the away from home sector indicates a move toward more convenience foods and a greater variety in food (Kusakabe and Anderson 1989).

The increase in eating out and consumption of processed foods can be attributed partly to increased leisure time and increased disposable incomes (JETRO 1987b). Hirasawa (1983) suggests that one of the reasons for the growth in the eating out sector was the decline in the number of households with extended families. In 1955 the average number of persons per family was 4.9, but by 1985 this had fallen to 3.2 (JETRO 1987a). Another possible reason for increased consumption outside the household is that more women are remaining in the workforce. Most shopping is now done after work and more meals are being consumed at restaurants in shopping areas (Williams 1989). This has contributed to the increase in seafood consumption in restaurants.

There is also an emerging trend toward health consciousness, which has led to a shift away from salted and dried products toward raw and fresh foods. In
addition, there has been an increase in demand for low calorie, low salt and low cholesterol foods. Consumers are becoming more conscious of food additives and colourings, and natural and organic foods are gaining in popularity (JETRO 1987c).

JETRO (1987b) identifies four trends that have emerged in response to the apparent diversification of consumer tastes: a trend toward smaller packaged foods, a trend toward convenience foods, a trend toward foods with more flavour, and a trend toward healthier foods.

Changes in food supplies
The rapid development of prawn aquaculture in South-East Asia since the mid-1970s — and the subsequent increase in supplies — is likely to have affected Japanese consumption patterns, particularly the consumption of seafood. Farmed prawn production reached 500 kt in 1989, compared with 286 kt in 1987. The Food and Agriculture Organization of the United Nations has forecast that Asian prawn aquaculture production is likely to be around 800 kt by the end of the century (FAO 1988). Using this forecast, and making the simplifying assumption of constant growth, Asian production of farmed prawns to the year 2000 is shown in figure L.

Japan has been the destination for much of the farmed prawn product from Asia and Japanese prawn imports almost doubled from 154 kt in 1983 to 273 kt in 1988. The share of farmed prawns in total prawn imports rose to 45 per cent in 1989, an increase of 7 per cent on 1988. With further growth in aquaculture production likely, this trend is expected to continue.

Given that domestic prawn catches were reasonably stable during this time, the growth in imports represents a significant increase in prawn supplies on the market. The growth in supplies has led to a fall in prawn prices in Japan, and these lower prices should stimulate domestic consumption.

Another development that will have an impact on the demand for meat and seafood products is the liberalisation of the Japanese beef market. In the past, the beef market has been highly regulated, with a quota on beef imports restricting supplies and a complex set of price stabilisation schemes maintaining domestic prices at artificially high levels. The replacement of Japanese import quotas by a regime of declining ad valorem tariffs is expected to result in increased beef supplies to the Japanese market (Harris 1990).

By the mid-1990s the expansion in beef imports is expected to result in a substantial fall in Japanese retail beef prices and increased demand for beef (Harris, Corra and Shaw 1989). The extent of the increase in beef consumption is unclear, but Nakase
(1990) cited a recent study from the Japanese Ministry of Agriculture, Forestry and Fisheries that forecast beef demand to grow by 4–5 per cent a year until the year 2000.

While beef consumption is likely to follow an upward trend for some time, the total food intake of the Japanese is not expected to grow in parallel. Daily caloric intake is forecast to increase only slightly, from 2620 in 1987 to 2630 by the year 2000 (Nakase 1990). Consequently, any increase in beef consumption will be at the expense of reduced consumption of other foods. Nakase suggests that rice consumption will continue to decline and that the increase in beef consumption will lead to a slowing down of the growth in demand for pork, chicken and seafood.

In summary, there have been a number of changes in food consumption patterns and in food supplies in Japan that may have a substantial impact on seafood demand. The likely effects of these changes on future seafood demand and their implications on the demand for Australian seafood exports are estimated using a model of Japanese meat and seafood demand, the details of which are presented in chapter 3.
Modelling the Japanese meat and seafood market

The Japanese meat and seafood market has been the focus of many demand studies. However, many of these studies concentrated on the demand for meat, with little attention given to estimating the demand for seafood. Not surprisingly, a wide range of seafood results have been reported.

In this chapter, the results from some recent studies of Japanese demand are reviewed and an outline is provided of the approach used in this study.

Previous demand studies

A thorough review of previous Japanese demand studies is contained in Coyle (1983) and Dyck (1988). The fishery results from many of these studies are difficult to compare because of variations in the data intervals, differences in the definition of income, and the diversity of products and species contained within the category of 'fish' (the Japanese consume around 600 different marine species). Dyck even suggested that estimates of fish demand must be viewed with some scepticism because of the seriousness of the aggregation problem.

Kester (1980) also recognised this problem, noting that aggregation and averaging will inevitably reduce the rigour of the analysis.

Another major difficulty encountered in many early studies has been the failure to identify significant substitution relationships between competing food groups. Despite the numerous studies that have been undertaken, Dyck concluded that there was no convincing evidence for either the substitution of meat for fish or vice versa.

Longworth (1983) reviewed several demand studies and reported results where changes in the price of fish had positive, negative and no effect on the consumption of meat. Sasaki (1982) and Mori and Lin (undated) encountered similar difficulties.

Two recent commodity-specific studies have identified substitution between fish and meat products. Taya (1988) found that a 10 per cent fall in the price of beef will result in a 23.8 per cent fall in tuna consumption. He rationalises this by suggesting that beef and tuna may be considered comparable in the sense that they are alternative choices for a high class or festive meal.

Herrmann, Mittlehammer and Lin (1989) found that the level of pork prices may have a significant impact on the level of salmon demand.

The use of a systems approach has been claimed to offer a superior method of estimating the demand relationships between meat and fish (Dyck 1988). The early attempts at estimating a system of demand equations — such as Yuize (1979) and Sawada (1980), using the Rotterdam model, and Sasaki (1982) and Sasaki and Fukagawa (1984), using a linear expenditure system — were only moderately successful, and the results
relating to fish obtained from these studies were poor.

Teal, Dickson, Porter and Whiteford (1987) used the Almost Ideal Demand System (Deaton and Muellbauer 1980) to estimate a meat and fish expenditure system containing four food categories: beef, pork, chicken and fish. They found that fish demand was relatively unresponsive to movements in fish prices, meaning that a change in price will lead to a less than proportional change in consumption, and that the share of fisheries products in meat and fish expenditure declines with rising income levels. They also found some evidence to suggest that beef and chicken are substitutes for fish.

Mori and Lin (undated) also used the Almost Ideal Demand System approach to estimate a demand system comprised of eight food groups — dairy beef, Wagyu beef, imported beef, pork, chicken, and three fish groups. Fish was disaggregated into high value, low value and processed groups. The demand for all three fish groups was found to be not very responsive to changes in their own price (higher valued fish had an estimated own-price elasticity of –0.74, lower valued fish –0.66, and processed fish –0.34 — see the boxed explanation of elasticities). They also found that the three fish groups are more likely to be complements than substitutes. Despite disaggregating fish into three categories, they found no consistent substitution effects between fish and the other food groups.

The model

Most Australian seafood exported to Japan is consumed at either special functions and ceremonies or in good quality restaurants (banana prawns are an exception and are generally consumed at the household level). Consequently, developments in the away from home sector of the market in Japan have the greatest effects on Australian seafood exporters. Modelling the away from home market was not possible due to a lack of data. Instead, a second best approach was used: the model was estimated at both the aggregate and household levels, and inferences about behaviour in the away from home sector...
were drawn from the differences in the results from the two levels.

The model developed for this study is based on a three stage budget allocation process. It is assumed that in the first stage, consumers determine their level of expenditure on meat and seafood; in the second stage, expenditure is allocated between seafood and the three meat categories — beef, pork and chicken; and in the final stage, expenditure is allocated between competing seafood commodities — crustaceans, tuna and other fish.

The purpose of the first stage of the analysis is to estimate the relative responsiveness of meat and seafood expenditure to changes in the price of meat and seafood and to changes in income. The relationship was estimated using single equation regression methods. The expenditure equation at the household level included a set of dummy variables to allow for changes in the price–expenditure relationship in the different age groups. The specification and results from the aggregate and household expenditure regressions are contained in appendix A.

In the second and third stages of the model, consumers allocate expenditure between competing seafood and meat products. The Almost Ideal Demand System model was applied to these two stages, and given that the aggregate and household sectors are treated separately a total of four models were estimated. More details on the model and the general form of the share equations are presented in appendix B, while the results from the four models are given in appendix C.

Own-price and cross-price elasticities were calculated using the parameter estimates from the model and mean value shares for the sample period. Expenditure elasticities can also be estimated using the parameters from the respective models. These elasticities represent the change in expenditure on each food group following a change in total expenditure.

An important development in the Japanese food market has been the apparent decline in household consumption of seafood by young people. If these young people continue to favour meat products as they age, this may lead to a reduction in seafood consumption across the whole population in the long term.

Cohort analysis was used to estimate the importance of factors other than price and income on the pattern of food consumption. Variables representing age and time were included in the household analysis (the two Almost Ideal Demand System models and the expenditure regression).

Using the parameters obtained from these models and keeping all variables except time constant at their 1988 levels, annual projections were made for household expenditure, expenditure shares and consumption for each of the six commodities for each cohort up to 1995. Changes in the projections are due entirely to the influence of consumer trends — such as the increased demand for convenience foods — that are embodied in the time variable.

The results from the cohort analysis should not be interpreted as forecasts: prices and incomes will change and will influence food consumption. Consumption will also be affected by the aging of the Japanese population. In 1970, 7 per cent of the Japanese
population was aged 65 and over; by 1986 this proportion had risen to nearly 11 per cent (Statistics Bureau 1988b). Given that the purpose in the cohort analysis was to identify the strength and direction of underlying trends in consumption behaviour, it was not necessary to include change in prices, incomes and population structure in the analysis. Detailed forecasts of Japanese seafood consumption could be undertaken at a later stage.

As discussed in the first section of this chapter, all studies of Japanese seafood demand encounter the difficult issue of classifying the vast range of seafood products into manageable and meaningful categories. A system of three categories is used in this study — crustaceans, tuna and other fish — in order to make the groupings more meaningful to Australian exporters.

Despite this three category approach, the analysis still has aggregation problems, for there are significant quality differentials within each category. For example, premium taisho prawns and common white prawns have been treated as common items in the crustaceans group, the low valued horse mackerel and the far preferred whiting appear together in the fish category, and southern bluefin and skipjack are grouped together in the tuna category. However, the aggregation problems are likely to be substantially less than those encountered in many previous demand studies.

Details of the data used in the study are outlined in appendix D, while the results from the model are presented and discussed in the following chapter.
Discussion of results

The meat and seafood system

The estimated unconditional elasticities for the aggregate meat and seafood system are presented in table 1. The results from the aggregate system are generally consistent with those reported in Dyck (1988). Demand for each commodity was inversely related to changes in its own price — a result consistent with economic theory.

The estimated elasticities for the meat and seafood system at the household level are presented in table 2. An interesting result is that the estimated own-price elasticity for chicken was not significant at the 10 per cent level. The implication of this result is that a fall in chicken prices may not have a strong impact on the level of household chicken consumption. One possible explanation for this is that the sustained fall that has occurred in chicken prices has led to an increase in chicken consumption away from home, especially in the convenience and fast food areas. Consumers eating more chicken away from home may be less likely to want chicken when eating at home, and so a fall in chicken prices may have little effect on household chicken consumption.

Relationship between seafood and beef

An understanding of the relationship between seafood and beef demand is of particular concern to the Australian seafood industry following the decision to liberalise the Japanese beef market. Beef supplies to Japan are forecast to

1 Elasticities for the aggregate meat and seafood system a

<table>
<thead>
<tr>
<th>Elasticity of demand for</th>
<th>Beef</th>
<th>Pork</th>
<th>Chicken</th>
<th>Seafood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef</td>
<td>-1.21**</td>
<td>0.61**</td>
<td>0.03</td>
<td>0.17*</td>
</tr>
<tr>
<td>(8.2)</td>
<td>(6.1)</td>
<td>(0.4)</td>
<td>(1.4)</td>
<td></td>
</tr>
<tr>
<td>Pork</td>
<td>0.46**</td>
<td>-0.67**</td>
<td>-0.11**</td>
<td>-0.17*</td>
</tr>
<tr>
<td>(5.8)</td>
<td>(7.4)</td>
<td>(1.8)</td>
<td>(1.4)</td>
<td></td>
</tr>
<tr>
<td>Chicken</td>
<td>-0.002</td>
<td>-0.24**</td>
<td>-0.23**</td>
<td>-0.21*</td>
</tr>
<tr>
<td>(0.1)</td>
<td>(2.2)</td>
<td>(1.8)</td>
<td>(1.5)</td>
<td></td>
</tr>
<tr>
<td>Seafood</td>
<td>0.02</td>
<td>-0.10**</td>
<td>-0.04*</td>
<td>-0.48**</td>
</tr>
<tr>
<td>(0.7)</td>
<td>(2.5)</td>
<td>(1.6)</td>
<td>(5.3)</td>
<td></td>
</tr>
</tbody>
</table>

a Estimated using annual data for the period 1965–88.
Note: The figures in parentheses are t-ratios which were calculated by a Monte Carlo simulations approach using the parameter estimates and the estimated variance-covariance matrix.
* Significant at the 10 per cent level. ** Significant at the 5 per cent level.
Elasticities for the household meat and seafood system

<table>
<thead>
<tr>
<th>Elasticity of demand for</th>
<th>with respect to the price of</th>
<th>Beef</th>
<th>Pork</th>
<th>Chicken</th>
<th>Seafood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef</td>
<td></td>
<td>-0.96**</td>
<td>0.09*</td>
<td>-0.16**</td>
<td>0.66**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5.9)</td>
<td>(1.3)</td>
<td>(2.0)</td>
<td>(5.4)</td>
</tr>
<tr>
<td>Pork</td>
<td></td>
<td>0.11*</td>
<td>-0.17**</td>
<td>-0.15*</td>
<td>-0.10*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.4)</td>
<td>(1.8)</td>
<td>(1.4)</td>
<td>(1.3)</td>
</tr>
<tr>
<td>Chicken</td>
<td></td>
<td>-0.34**</td>
<td>-0.30*</td>
<td>0.40</td>
<td>-0.07</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.8)</td>
<td>(1.4)</td>
<td>(1.2)</td>
<td>(0.6)</td>
</tr>
<tr>
<td>Seafood</td>
<td></td>
<td>0.26**</td>
<td>-0.05**</td>
<td>-0.02</td>
<td>-0.59**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5.2)</td>
<td>(1.7)</td>
<td>(1.0)</td>
<td>(11.8)</td>
</tr>
</tbody>
</table>

* a Estimated using annual data for the period 1980-88.

Note: The figures in parentheses are t-ratios which were calculated by a Monte Carlo simulations approach using the parameter estimates and the estimated variance-covariance matrix.

* Significant at the 10 per cent level. ** Significant at the 5 per cent level.

increase rapidly, and beef consumption in 1991 is expected to be 17 per cent above 1989 levels (Harris, Dickson, Gerardi and Corra 1990).

Beef demand, at both the aggregate and household level, was found to be more responsive to price changes than was the demand for pork, chicken or seafood to changes in their own price. This result is consistent with the findings from other studies reviewed in chapter 3. Any fall in beef prices will lead to a more than proportional increase in total beef consumption, with a 1 per cent fall in prices resulting in a more than 1 per rise in aggregate beef consumption. Although household beef consumption would increase, the change would be larger in the away from home sector.

This result may have favourable implications for future Australian beef exports to Japan, but the effects on Australian seafood exports are less certain. No significant relationship was found between beef prices and seafood consumption at the aggregate level. This suggests that seafood consumption may not fall in the face of increasing beef consumption. At the household level, there is some substitution between beef and seafood, indicating that a fall in beef prices may lead to lower seafood demand. However, lower seafood demand at the household level is unlikely to have a strong impact on the demand for Australian seafood exports given that they are targeted mainly at the away from home market.

From the results, it appears that in Japan pork and beef are close substitutes at the aggregate level. This finding is consistent with a number of previous studies (Kester 1980; Yuize 1966, 1979; Sawada 1980; Dyck 1988; Teal et al. 1987). Any fall in beef prices is likely to have a substantial adverse effect on pork consumption, and this fall will be stronger in the away from home market.

It should be noted that the consumption relationships identified in this study apply to the period before the liberalisation of the beef industry, when beef supplies, and consequently beef consumption, did not reflect the level of beef demand. Beef prices were maintained at artificially high levels, encouraging potential beef consumers to purchase other food products. The
magnitude of the expected change in beef supplies — and subsequently prices — following trade liberalisation is likely to be substantial and, consequently, these results may underestimate the effects of any increase in beef consumption on seafood demand. However, it does seem that any changes in seafood consumption will occur primarily at the household level, and since most Australian seafood is targeted at the away from home market, it seems unlikely that the changes taking place in the beef market will substantially reduce the demand for Australian seafood exports.

Impact of aquaculture on seafood consumption

The demand for seafood at the aggregate level in Japan was found to be inelastic with respect to seafood prices. Consequently, any fall in seafood price due to an increase in supplies will lead to a less than proportional increase in total seafood consumption. Seafood demand at the household level was also found to be inelastic, with a 1 per cent fall in price leading to a 0.6 per cent increase in consumption. However, given that the aggregate seafood group represents all fresh and frozen seafood, the results from the aggregate level cannot be used to estimate the price relationships for particular seafood products.

A feature of the model developed for this study was the estimation of a second level seafood system comprising three seafood categories — crustaceans, tuna and other fish. The advantage of this seafood system is that it enables the relationships between the different seafood categories to be estimated. The estimated elasticities for the seafood commodities (derived from the parameters of the seafood system) at the aggregate level are given in table 3.

Demand for each of the three seafood commodities was estimated to be inelastic, meaning that a change in their own price will lead to a less than proportional change in demand. The demand for crustaceans was found to be more price responsive than the demand for the other two commodities. Some complementarity was found between the seafood demand for tuna and other fish, but this was the only significant relationship that was identified between

<table>
<thead>
<tr>
<th>Elasticity of demand for</th>
<th>with respect to the price of</th>
<th>Crustaceans</th>
<th>Tuna</th>
<th>Other fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crustaceans</td>
<td></td>
<td>-0.67**</td>
<td>0.23*</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.7)</td>
<td>(1.4)</td>
<td>(0.9)</td>
</tr>
<tr>
<td>Tuna</td>
<td></td>
<td>0.18*</td>
<td>-0.37**</td>
<td>-0.12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.6)</td>
<td>(3.1)</td>
<td>(1.0)</td>
</tr>
<tr>
<td>Fish</td>
<td></td>
<td>-0.03</td>
<td>-0.33**</td>
<td>-0.47**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.03)</td>
<td>(3.3)</td>
<td>(2.8)</td>
</tr>
</tbody>
</table>

a Estimated using annual data for the period 1980-88.

Note: The figures in parentheses are t-ratios which were calculated by a Monte Carlo simulations approach using the parameter estimates and the estimated variance-covariance matrix.

** Significant at the 5 per cent level.

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the seafood commodities. The estimated elasticities for the household seafood system are shown in table 4.

Demand for individual seafood commodities, particularly crustaceans, exhibited relatively strong price elasticities. Significant substitution effects between the seafoods were also identified, which means that a fall in the price of one commodity will lead to increased consumption of that food and less consumption of the other two. This implies that there is strong competition between the different types of seafood, and that price is an important factor in determining the type of seafood consumed at the household level.

Aggregate consumption represents both home and away from home consumption, and any difference in the results between the home and aggregate analyses will in part reflect behaviour in the away from home market. However, it must also be remembered that the data from the household and aggregate sectors are not comparable, and this will also be a factor that will create differences between the two sets of results.

It is not possible to draw direct conclusions from these results about the price responsiveness of seafood demand in the away from home sector. However, given that seafood is a traditional food in many Japanese functions and ceremonies (such as weddings), demand in the away from home sector is likely to be relatively unresponsive to changes in price. The results are consistent with this claim, for the lower price elasticities in the aggregate seafood system is an indication that factors other than price are important influences on away from home seafood consumption.

Aggregate crustaceans demand was found to be inelastic to changes in their own price, meaning that any fall in the price of crustaceans may lead to a less than proportional increase in aggregate consumption. In contrast, demand at the household level was very price elastic, and there may be considerable potential to increase household consumption of crustaceans, albeit at lower prices. In addition, the substitution relationships between the seafood categories identified at the household level are an indication that some of the increase in consumption of crustaceans will be at the expense of reduced consumption of tuna and other fish.

### Elasticities for the household seafood system a

<table>
<thead>
<tr>
<th>Elasticity of demand for</th>
<th>Crustaceans</th>
<th>Tuna</th>
<th>Other fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crab</td>
<td>-4.42**</td>
<td>0.09</td>
<td>3.67**</td>
</tr>
<tr>
<td></td>
<td>(17.7)</td>
<td>(0.6)</td>
<td>(15.9)</td>
</tr>
<tr>
<td>Tuna</td>
<td>0.10</td>
<td>-0.91**</td>
<td>0.44**</td>
</tr>
<tr>
<td></td>
<td>(0.8)</td>
<td>(6.5)</td>
<td>(3.1)</td>
</tr>
<tr>
<td>Fish</td>
<td>0.50**</td>
<td>0.05**</td>
<td>-1.17**</td>
</tr>
<tr>
<td></td>
<td>(16.7)</td>
<td>(2.5)</td>
<td>(29.3)</td>
</tr>
</tbody>
</table>

*a* Estimated using annual data for the period 1980–88.

**Note:** The figures in parentheses are t-ratios which were calculated by a Monte Carlo simulations approach using the parameter estimates and the estimated variance–covariance matrix.

* Significant at the 10 per cent level. ** Significant at the 5 per cent level.
Estimated expenditure elasticities

The parameter estimates from the Almost Ideal Demand System model were used to obtain estimates of expenditure elasticities (table 5). The estimated elasticities represent the percentage change in consumption of each food item in response to a change in total expenditure, measured using per person living expenditure data obtained from the Family Income and Expenditure Surveys (Statistics Bureau 1988a). For example, the interpretation of the aggregate seafood estimate (1.22) is that a 1 per cent increase in total expenditure will lead to a rise in aggregate seafood consumption of 1.22 per cent. In contrast, the seafood estimate at the household level (-0.14) means that a 1 per cent increase in total expenditure will result in a 0.14 per cent fall in household seafood consumption.

As expenditure increases, aggregate seafood consumption rises yet household consumption declines: the implication of these contrasting responses is that any increase in expenditure will lead to substantial growth in away from home seafood consumption.

Aggregate meat and seafood consumption will continue to grow as total expenditure increases. However, the results indicate that as total expenditure increases, household consumption of these commodities is likely to decline. Consumption of the three meat products may fall at a similar rate, while seafood consumption is likely to be the slowest to decline. In other words, the growth in consumption will probably take place in the away from home sector.

Increases in expenditure are likely to stimulate more than proportionate increases in aggregate chicken and pork consumption, while aggregate beef consumption may grow a little less quickly than expenditure. Seafood consumption is expected to increase strongly with increasing consumer expenditure, and given that the growth is likely to occur in the away from home market, this should boost demand for Australian seafood.

The strict regulatory controls on Japanese beef imports in the past may have contributed to the relatively low elasticity estimate for aggregate beef. The quantity of beef supplied to the Japanese market has been determined not by the level of demand but by the level of import quotas. These restrictions placed a ceiling on the level of beef consumption, and changes in beef demand would have been reflected more by movements in price than by changes in consumption. This means that at the aggregate level there is a weak relationship between beef consumption and changes in total expenditure. This relationship is expected to change following the removal of Japan's quantitative restrictions on beef imports in the early 1990s.

<table>
<thead>
<tr>
<th>Elasticity of expenditure on</th>
<th>Aggregate</th>
<th>Household</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef</td>
<td>0.80</td>
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<tr>
<td>Pork</td>
<td>1.03</td>
<td>-0.24</td>
</tr>
<tr>
<td>Chicken</td>
<td>1.40</td>
<td>-0.24</td>
</tr>
<tr>
<td>Seafood</td>
<td>1.22</td>
<td>-0.14</td>
</tr>
</tbody>
</table>

*Estimated at the aggregate level using annual data for the period 1964-88 and at the household level using annual data for the period 1980-88.*

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Demographic influences on consumption

As discussed in the previous chapter, cohort analysis was used to identify the significance of lifestyle factors in determining consumption patterns. Since prices were held constant at their 1988 levels, any change in expenditure may be interpreted as a change in consumption. These results do not represent forecasts but are indicators of the underlying trends in consumption behaviour.

Household expenditure

The levels of aggregate household expenditure on meat and seafood for selected age groups for the period 1988–95 are shown in figure M. The graph indicates that household meat and seafood consumption is declining among the younger age groups, slightly falling in the middle age groups, and stable in the older groups. The trend toward reduced household consumption of meat and seafood is strongest among young people, but over time, as these young people age, the trend will become common to a wider spread of the population. This suggests that household consumption may continue to fall and, as household consumption falls, consumption away from home will increase.

**Household seafood consumption**

Over time, household seafood consumption decreases for each age group except for the 60–64 year old group whose consumption showed a slightly increasing trend (figure N). The decrease was strongest for the younger age groups. The trend of reduced household seafood consumption also appears likely to spread into other age brackets over time. All age groups showed a decrease in household consumption of crustaceans, and in this case the fall is greatest in the older age groups (figure O).

Results from the cohort analysis also indicate that household consumption of tuna may also decline over time (figure P). The findings for tuna consumption show a widespread fall in consumption across the population, although the decline is greater in the younger age groups. If the decline in household

### Household expenditure on seafood per person in Japan

<table>
<thead>
<tr>
<th>Age Group</th>
<th>1989</th>
<th>1991</th>
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<td>60-64 years</td>
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<tr>
<td>45-49 years</td>
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<td>30-34 years</td>
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<tr>
<td>25-29 years</td>
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</table>

Real income and prices fixed at their 1988 level

---

Japanese seafood market
Household expenditure on crustaceans per person in Japan

<table>
<thead>
<tr>
<th>By age group</th>
<th>1989</th>
<th>1991</th>
<th>1993</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0 55-59 years</td>
<td>1.5 60-64 years</td>
<td>2.0 45-49 years</td>
<td>1.5 30-34 years</td>
<td>1.0 25-29 years</td>
</tr>
</tbody>
</table>

Household expenditure on tuna per person in Japan

<table>
<thead>
<tr>
<th>By age group</th>
<th>1989</th>
<th>1991</th>
<th>1993</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0 60-64 years</td>
<td>3.0 55-59 years</td>
<td>2.0 45-49 years</td>
<td>1.0 30-34 years</td>
<td>1.0 25-29 years</td>
</tr>
</tbody>
</table>

Unfortunately, data limitations prevent an extension of the cohort analysis into the away from home market. The impact of lifestyle factors on the demand for seafood in the away from home sector requires further research.

Implications for promoting Australian banana prawns

There has been a lot of attention focused on the issue of seafood promotion in recent years (Senate Standing Committee on Trade and Commerce 1982; Haling 1986; Australian Science and Technology Council 1988; Battaglene and Geen 1990).

The case for promotion received added impetus in 1989 following the problems experienced by the Australian banana prawn industry in marketing its product in Japan (see, for example, France, as quoted in Macreadie 1990; and Tiller 1990). The theoretical aspects of seafood promotion have been discussed by Battaglene and Geen (1990), but little empirical analysis has been attempted.

As discussed in chapter 2, the recent growth in Asian aquaculture production has resulted in a substantial increase in the supply of prawns to the Japanese market. This development has had an adverse effect on the demand for banana prawns, because banana prawns are in direct competition with the farmed prawns (the pale colouring and small size of the banana prawn limits its acceptance into the higher priced segments of the Japanese market: consequently, banana prawns are consumed mainly at the household level and sold alongside farmed prawns through retail outlets).
The lower production costs of the Asian farmed prawns relative to the Australian sea caught prawns (Battaglene and Kingston 1990) has meant that farmed prawns can be sold at cheaper prices, and this, together with the growth in supplies, has led to a fall in retail prawn prices in recent years. This has in turn been reflected in a fall in the prices received by Australian producers; in 1989, ex vessel prices for banana prawns were 40 per cent lower than in 1988 (Battaglene and Kingston 1990).

The objective in any promotional campaign is to increase sales volume, realise higher prices, or both. Ball and Dewbre (1989) referred to these outcomes as the quantity and price effects, and noted that the magnitude of the two effects will be determined by the price elasticities of demand and supply. If the demand and supply of a particular product are highly responsive (highly elastic) to changes in its own price and to changes in the price of competing products, then the quantity effects — the increased sales volume — are likely to be greater than the price effects. If demand and supply are not highly responsive to these changes in prices, then the price effects are likely to be greater.

Quilkey (1986) identified two alternative strategies for a promotional campaign. If the aim in the campaign is to increase sales volume, then emphasis should be given to the diversity of the product, highlighting its broad range of end uses and thereby increasing its competitiveness with other commodities. If the aim is to maintain sales but at higher prices, then the campaign should be focused on the uniqueness of the product, effectively reducing the attractiveness of competing products. The strategy employed thus depends on the particular aim of the campaign, which in turn is determined by the elasticities of supply and demand.

The Australian banana prawn fishery is considered to be fully exploited, and it is not possible for supplies of these prawns to increase in response to a change in price. In economic terms, this means that supply is inelastic. Consequently, a promotional campaign that was designed to increase prawn consumption would be unlikely to increase the returns to Australian producers. Instead, the aim of the promotion should be to obtain a higher price for Australian banana prawns, and the appropriate strategy would be to emphasise the ‘special and desirable’ qualities of the Australian product.

The Australian banana prawn does have some obvious marketing features — it is a natural, sea caught prawn taken from clean waters — and a promotional campaign could encourage consumers to pay a premium for these desirable qualities. Successful promotion also relies on consumers being able to differentiate Australian prawns from prawns from other countries, and improved grading, smaller packaging and brand labelling may be necessary (Battaglene and Geen 1990).

Brand naming is one promotional measure that may help the consumer differentiate between domestic and imported products. This could be particularly effective at the household retail level, but would require Australian seafood to be exported in consumer packs, and not in bulk packs to be repacked in Japan as is presently the case for most Australian seafood.
These properties — the existence of special characteristics and the ability to differentiate the Australian product — are necessary if consumers are to pay a premium for the Australian product. Another factor that needs to be considered is the sensitivity of demand to changes in price. As previously mentioned, a promotional campaign designed to increase the price of a certain product will be more likely to succeed when demand and supply are not highly responsive to changes in its own price and the prices of competing products (Ball and Dewbre 1989).

Assuming that prawn producers cannot increase the supply of prawns in response to higher prices, the degree to which prices are affected by promotion depends on the responsiveness of demand. The more responsive demand is to price changes then the less are the effects of promotion on market price (Ball and Dewbre 1989).

Given that prawns are the dominant commodity in the crustaceans category and that the demand for prawns is closely related to the demand for crustaceans, the estimated own-price, cross-price and expenditure elasticities presented in tables 3, 4 and 5 can be used to assess the likely chances of success of a prawn promotional campaign.

The estimated own-price elasticity for crustaceans from the household study is very high (4.4), and demand for any subset of the crustaceans group — such as Australian banana prawns — is likely to be even higher. This means that demand is highly sensitive to changes in price, and price is an extremely influential factor in determining the level of prawn consumption. There is also likely to be strong price competition between different prawn suppliers. These results are not consistent with the aim of encouraging consumers to pay a premium for Australian banana prawns.

The choices of consumers are also influenced by socioeconomic and demographic factors (Bartley, Ball and Weeks 1988), and the results from the cohort analysis also have implications for the promotion issue.

One result from the cohort analysis was that lifestyle factors are having a negative influence on household crustacean consumption (as shown in figure 0). This trend was evident across all age groups, and was strongest in the older households. The implication from this finding is that the recent growth in household prawn consumption is largely due to the fall in price: if income and prices were unchanged, prawn consumption may have in fact fallen.

If the reasons for the underlying downward trend in prawn consumption can be identified, exporters may be able to use this information to change their current marketing practices and make banana prawns more desirable to consumers. This is already happening to some extent with an increase in the number of suppliers selling their product in retail sized packs rather than bulk export packs.

However, consumers may be unwilling to pay a premium for banana prawns given the price sensitive nature of household seafood consumption and any promotional campaign may not succeed.
Expenditure regressions

Meat and seafood expenditure at the aggregate level for the period 1965–88 was estimated using the following model

\[
\ln E = a + b_1 \ln P + b_2 \ln Y
\]

where \( E \) is aggregate meat and seafood expenditure, \( P \) is the price of meat and seafood (using Stone’s price index), and \( Y \) is income (as measured by average household living expenditure). All variables were deflated by the Japanese consumer price index.

The expenditure equation at the household level included a set of dummy variables to allow for changes in the price–expenditure relationship in the different age groups and a simple time variable.

Since the model is in double log form, the parameter estimates represent expenditure elasticities, and since the effects on expenditure following a change in price of any commodity are known, estimates of unconstrained price elasticities can then be determined.

The estimated own-price elasticities for the meat and seafood systems were used to obtain the required expenditure parameters needed to obtain unconstrained elasticity estimates for the seafood systems.

The parameter estimates (and the corresponding t-ratios) from the aggregate and household expenditure regressions are presented in the next column.

**Aggregate meat and seafood expenditure**

\[
\ln E = -10.54 + 0.56 \ln P + 1.71 \ln Y
\]

\[
(29.62) \quad (6.41) \quad (34.88)
\]

\( R^2 = 0.99 \quad \bar{R}^2 = 0.99 \quad F = 1147.7 \)

**Household meat and seafood expenditure**

\[
\ln E = 6.21 + 0.51 \ln P - 0.18 \ln Y - 0.04 T
\]

\[
(7.1) \quad (2.5) \quad (2.1) \quad (8.6)
\]

\[+ 0.001 TA - 0.31 A_1 - 0.25 A_2 - 0.23 A_3\]

\[
(6.2) \quad (15.8) \quad (15.7) \quad (15.3)
\]

\[- 0.13 A_4 + 0.1 A_6 + 0.15 A_7 + 0.16 A_8\]

\[
(8.5) \quad (5.3) \quad (5.7) \quad (6.1)
\]

\[+ 0.11 A_9 - 0.0003 A_{10}\]

\[
(6.0) \quad (0.01)
\]

\( R^2 = 0.98 \quad \bar{R}^2 = 0.98 \quad F = 320.8 \)

where \( E \) is expenditure on meat and seafood, \( P \) is the price of meat and seafood, \( Y \) is income, \( T \) is time, \( TA \) is time/age, and \( A_1 \) to \( A_{10} \) are dummy variables for the age group of the household head, \( A_1 = < 24, A_2 = 25–29, A_3 = 30–34, A_4 = 35–39, A_5 = 45–49, A_7 = 50–54, A_8 = 55–59, A_9 = 60–64, A_{10} = > 65, A_6 = 40–45 \) is the base.
The Almost Ideal Demand System model

The demand equations were estimated using a linear approximation of the Almost Ideal Demand System developed by Deaton and Muellbauer (1980). This approach has been used in many recent demand studies (for example, Blanciforti and Green 1983a,b; Chalfant 1987; Fulponi 1989; Teal et al. 1988; Eales and Unnevehr 1988). Using this systems approach, the restrictions of homogeneity, compensated price symmetry and adding up were imposed directly through the model. This reduces the number of parameters to be estimated and thereby improves the efficiency of the parameter estimates.

Parameter estimates for the demand equations were derived by estimating a system of value share equations. The general form of the share equations is given by:

$$ w_i = a_i + \sum b_{ij} \ln p_j + \partial_i \ln (E/P') $$

where $w_i$ represents the share of expenditure on commodity $i$; $b_{ij}$ and $\partial_i$ are parameters to be estimated; $p_j$ is the price of product $j$; $E$ is expenditure on the system; and $P'$ represents the level of prices within the system, estimated by Stone's price index:

$$ P' = \prod p_j^{w_i} $$

Green and Alston (1990) note that there may be empirical problems in using the original price index developed by Deaton and Muellbauer (1980), particularly when analysing aggregate annual time series data. As a result of these problems, it is common to use Stone's price index.

The term $(E/P')$ is interpreted as representing real income (assuming a constant level of savings).

The restrictions on the model parameters are given by:

$$ \sum b_{ij} = 0, \text{ homogeneity}, $$

$$ b_{ij} = b_{ji}, \text{ symmetry}, $$

$$ \sum a_i = 1, \text{ and} $$

$$ \sum \partial_i = \sum b_{ij} = 0, \text{ adding up}. $$

The model was initially estimated with all six food categories in the one system but this approach proved unsuccessful. The results were inconsistent with economic theory and not statistically robust. These problems may be due to the limited number of observations, particularly at the aggregate level. Imposing the assumption of a two-step budget allocation reduced the number of food parameters to be estimated from fifteen to nine. This improved the efficiency of parameter estimation, though at the expense of limiting the flexibility of the relationships between the individual seafood and meat categories. For example, the model can be used to estimate the effect of a fall in
beef prices on aggregate seafood demand, but is not well suited to estimate the effect on the demand for the individual seafood categories.

The richness of the data available for the household level analysis enabled demographic variables to be incorporated into the share equations in addition to the price and expenditure variables. These additional data were included to account for the influence of non-price factors which may have a substantial effect on the consumption decision. For example, Kester (1980) concluded that fish consumption could not be fully explained by price and income factors, while Williams (1989) has suggested that the changes in consumers' incomes and lifestyles have led to a change in food preferences.

Nine dummy variables were included in the household analysis to allow for differences in consumption between the ten age cohorts. These dummy variables capture the aging effect — that is, changes in taste as people grow older. A time variable was included to allow for changes in consumption over time, and a time/age variable was included to allow for change between cohorts over the sample period, reflecting the aging effect over time.

Comparable demographic data were not available for the aggregate level study, and the only addition to the general form of the Almost Ideal Demand System equation for the aggregate analysis was the inclusion of a time variable.
Results from the modelling

The Almost Ideal Demand System model was applied to meat and fish expenditure in Japan. In the meat and seafood system, expenditure was allocated between one seafood category and three meat categories — beef, pork and chicken. In the seafood system, seafood was disaggregated into three categories — crustaceans, tuna and other fish. This approach was applied to both aggregate and household consumption, meaning a total of four models were estimated.

**Aggregate meat and seafood system**

**Beef**

\[ Beef = 0.31 - 0.06 P_b - 0.009 P_c + 0.09 P_p - 0.06 Y + 0.008 T \]

\[(5.44) \quad (2.19) \quad (0.51) \quad (4.84) \quad (2.64) \quad (9.21) \]

\[ R^2 = 0.92 \]

**Chicken**

\[ Chicken = 0.08 - 0.009 P_b + 0.1 P_c - 0.04 P_p + 0.03 Y + 0.001 T \]

\[(1.56) \quad (0.51) \quad (5.32) \quad (2.78) \quad (1.22) \quad (1.54) \]

\[ R^2 = 0.86 \]

**Pork**

\[ Pork = 0.34 + 0.09 P_b - 0.04 P_c + 0.05 P_p - 0.04 Y - 0.001 T \]

\[(5.03) \quad (4.84) \quad (2.78) \quad (1.98) \quad (1.55) \quad (1.23) \]

\[ R^2 = 0.94 \]

where **Beef**, **Chicken**, **Pork** are the respective shares of these meats in total meat and seafood expenditure; \( P_b \) is the price of beef; \( P_c \) is the price of chicken; \( P_p \) is the price of pork; \( Y \) is income; and \( T \) is time. Figures in parentheses are \( t \)-values.

**Aggregate seafood system**

**Crustaceans**

\[ Crustaceans = 0.25 + 0.04 P_c - 0.002 P_p - 0.06 Y + 0.003 T \]

\[(1.81) \quad (0.85) \quad (0.06) \quad (1.25) \quad (4.3) \]

\[ R^2 = 0.59 \]

**Tuna**

\[ Tuna = 0.59 - 0.002 P_c + 0.15 P_t - 0.18 Y + 0.006 T \]

\[(2.96) \quad (0.06) \quad (3.13) \quad (2.48) \quad (4.88) \]

\[ R^2 = 0.91 \]

where **Crustaceans**, **Tuna** are the respective shares of these seafoods in total seafood expenditure; \( P_t \) is the price of tuna; \( Y \) is income; and \( T \) is time. Figures in parentheses are \( t \)-values.

**Household meat system**

**Beef**

\[ Beef = 0.18 - 0.02 P_b - 0.05 P_c - 0.006 P_p + 0.001 Y + 0.006 T - 0.0001 A \]

\[(2.28) \quad (0.56) \quad (2.86) \quad (0.37) \quad (0.02) \quad (4.96) \quad (2.68) \]

\[- 0.005 D_1 - 0.008 D_2 - 0.01 D_3 - 0.006 D_4 + 0.003 D_6 + 0.001 D_7 - 0.008 D_8 \]

\[(0.45) \quad (1.04) \quad (1.65) \quad (1.61) \quad (1.23) \quad (0.25) \quad (1.91) \]

\[- 0.02 D_9 - 0.02 D_{10} \]

\[(4.96) \quad (5.80) \]

\[ R^2 = 0.91 \]
**Chicken** = 0.22 - 0.05 \( P_b \) + 0.13 \( P_c \) - 0.04 \( P_p \) - 0.01 \( Y \) + 0.004 \( T \) - 0.00005 \( A \)  
(5.89) (2.86) (4.26) (1.94) (1.16) (5.71) (5.08)  
\(- 0.002 D_1 \) - 0.007 \( D_2 \) - 0.008 \( D_3 \) - 0.005 \( D_4 \) - 0.001 \( D_6 \) - 0.009 \( D_7 \) - 0.02 \( D_8 \)  
(0.42) (2.4) (3.0) (3.33) (0.82) (5.96) (10.33)  
\(- 0.02 D_9 \) - 0.02 \( D_{10} \)  
(10.95) (9.53) \( R^2 = 0.95 \)

**Pork** = 0.30 - 0.006 \( P_b \) - 0.04 \( P_c \) + 0.13 \( P_p \) - 0.03 \( Y \) - 0.001 \( T \) + 0.00003 \( A \)  
(4.96) (0.37) (1.94) (7.35) (1.46) (1.15) (1.59)  
\(+ 0.04 D_1 \) + 0.01 \( D_2 \) - 0.003 \( D_3 \) - 0.005 \( D_4 \) - 0.001 \( D_6 \) - 0.02 \( D_7 \) - 0.04 \( D_8 \)  
(4.82) (1.90) (0.71) (1.77) (0.6) (8.74) (14.17)  
\(- 0.05 D_9 \) - 0.06 \( D_{10} \)  
(16.7) (20.19) \( R^2 = 0.98 \)

where **Beef, Chicken, Pork, P_b, P_c, P_p, Y, T, A**, \( D_{3,7,9} = 30-34, D_4 = 35-39, D_6 = 45-49, D_7 = 50-54, D_8 = 55-59, D_9 = 60-64, D_{10} = > 65. D_5 = 40-45 \) is the base. Figures in parentheses are t-values. and \( D_1 \) to \( D_{10} \) are dummy variables for the age group of the household head, \( D_1 = < 24, D_2 = 25-29, \)...

---

**Household seafood system**

**Tuna** = 0.26 - 0.35 \( P_t \) + 0.004 \( P_c \) + 0.01 \( Y \) + 0.002 \( T \) - 0.0001 \( A \) + 0.01 \( D_1 \)  
(3.55) (14.49) (0.23) (0.36) (0.86) (2.08) (0.83)  
\(+ 0.02 D_2 \) + 0.007 \( D_3 \) + 0.002 \( D_4 \) + 0.004 \( D_6 \) + 0.004 \( D_7 \) + 0.002 \( D_8 \)  
(1.78) (0.96) (0.41) (1.0) (0.54) (0.27)  
\(- 0.002 D_9 \) - 0.002 \( D_{10} \)  
(0.21) (0.28) \( R^2 = 0.78 \)

**Crustaceans** = 0.28 - 0.004 \( P_t \) - 0.001 \( P_c \) -0.05 \( Y \) - 0.003 \( T \) + 0.00002 \( A \) - 0.04 \( D_1 \)  
(5.19) (0.23) (0.03) (2.47) (2.1) (0.75) (3.73)  
\(- 0.04 D_2 \) - 0.03 \( D_3 \) - 0.01 \( D_4 \) + 0.007 \( D_6 \) + 0.002 \( D_7 \) + 0.02 \( D_8 \)  
(6.22) (6.06) (5.28) (2.66) (4.97) (3.62)  
\(- 0.02D_9 \) - 0.01\( D_{10} \)  
(3.09) (2.82) \( R^2 = 0.80 \)

where **Tuna, Crustaceans, P_t, P_c, Y, T, A, D_1**. Figures in parentheses are t-values. and \( D_1 \) to \( D_{10} \) are as defined earlier.
Data

Data for the household study were derived from the annual reports of the Family Income and Expenditure Survey organised by the Japanese Statistics Bureau (1988a). This survey has been conducted annually since 1950, with approximately 8000 households surveyed each month. The sample undergoes continuous replacement, with one-sixth of the sample replaced each month and each household remaining in the sample for six months.

The survey provides mean household consumption and expenditure data for a wide range of food and non-food items stratified by a number of different social indicators, such as geographic, income and age variables. The data selected for this analysis were stratified by the average age of household head. Organising the data in this manner meant that the household sector could be analysed using cohort analysis. Mean household data by age of household head have been produced since 1979, and the household analysis covers the ten year period 1979–88.

A household is defined as a group of two or more persons sharing a house and living expenses. However, as Dyck (1988) points out, about 25 per cent of all Japanese households are excluded from the survey. Households of only one person, households whose primary income is derived from farming, fishing or forestry, households selling food or lodgings, households with more than four live-in employees, households whose head is absent, and households of foreigners are not included in the survey sample.

The household head is defined as the main income earner in the household. Age of household head is stratified into ten age groups: 24 and younger, 25–29, 30–34, and so on, with the final group having a household head 65 and over.

Household consumption data were collected for six meat and seafood commodities: beef, chicken, pork, crustaceans, tuna and other fresh fish. Bonito (skipjack tuna) — a separate classification in the household survey — is included in the tuna category. The crustaceans category is comprised of prawns, lobsters and crabs.

Other data collected included total living expenditure (household expenditure on a range of food and non-food items), and number of people per household. The data were divided by the respective number of people per household to obtain per person data for each cohort. A weight variable was used to reflect the distribution of each cohort in the population.

Prices are implicitly calculated in the household survey by dividing expenditure by consumption. Due to quality variations within each food commodity, prices vary across cohorts as well as across time. The implicit prices from each cohort were then averaged to obtain one price for all
cohorts for each commodity in any given year. By using this weighted average price, emphasis is given to the quantity rather than quality component of demand. In addition, averaging across all cohorts should make the price variable more representative of variation in price over time. Tuna price was calculated as the weighted average of tuna and bonito prices. A similar procedure was used to calculate a weighted price series for crustaceans from price series for prawns and lobster, and crabs.

Expenditure per cohort was calculated by multiplying consumption by price, and expenditure shares were then obtained for each cohort over time. Given that there were ten observations — one for each cohort — for each of the ten years, the data set for the household analysis is comprised of 100 observations.

Data for aggregate consumption was more difficult to identify, particularly for seafood consumption. Apparent consumption series for beef, pork and chicken were obtained from the Ministry of Agriculture, Forestry and Fisheries (1987). The corresponding series for fresh/frozen fish and shellfish consumption needed to be disaggregated into separate tuna, crustaceans and other fresh fish categories. A standard supply utilisation approach was used to derive the disaggregated seafood data, namely:

\[
\text{apparent consumption} = (\text{imports} + \text{domestic production}) - (\text{exports} + \text{changes in stock levels}).
\]

Apparent consumption series were calculated for crustaceans and tuna. Annual consumption of other fresh fish was obtained by subtracting the series for crustaceans and tuna from the aggregate fish consumption series.

Import and export information were collected from trade data compiled by the Japanese Ministry of Finance (1988). Domestic production data were obtained from the Ministry of Agriculture, Forestry and Fisheries (1987). Official production data for 1988 were not available at the time of this study, and were estimated as 130 kt for crustaceans and 800 kt for tuna. These estimates were consciously set higher than the previous year’s levels so that any error involved would overstate domestic seafood consumption. Alternatively, the study could have been restricted to 1987, but this did not seem appropriate given that 1988 data were available for all other necessary variables and that these estimates should be reasonably accurate.

Data for prawn stocks were drawn from Suisan Nenkan (1985) and from the US Department of Commerce (1988). Details of tuna stocks were obtained from data supplied by the Japanese External Trade Organisation. It was assumed that there was no significant change in the stocks of lobster and crabs over the period.

The data were converted from product weight into a net food weight basis. Conversion rates used for the three meat groups were: beef 0.7, pork 0.7, chicken 0.77 (Ministry of Agriculture, Forestry and Fisheries 1987). Converting the seafood groups was more complex. Exports of canned tuna were transformed into product weight using a rate of 2.38 (Bureau of Agricultural Economics 1984), and then a conversion rate of 0.52 (Ministry of Agriculture, Forestry and Fisheries 1987) was applied to the crustaceans, tuna and aggregate fish and

Japanese seafood market

35
shellfish series to convert these series into net food weight.

Data were expressed in per person terms by dividing aggregate consumption by population using data obtained from the Japanese Statistics Bureau (1988b). Prices used in the aggregate model are retail prices from the Ku area of Tokyo (Statistics Bureau 1988b). Expenditure and expenditure shares were obtained using the price and consumption data.

The distortions to the data, particularly to seafood consumption, resulting from the use of specific conversion rates are recognised. The importance of this issue was assessed by running the model using a range of alternative seafood conversion rates. The use of different rates had little impact on the elasticity estimates, and the estimates appear to be robust despite the conversion problems.

The data set for the aggregate consumption analysis contains annual observations on prices and consumption for the period 1965–88.
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