AN ABSTRACT OF THE THESIS OF

Berhanu Anteneh for the Degree of Master of Science in Agricultural and Resource Economics Presented on September 28, 1990.

Title: The Japanese Beef Market in a Disequilibrium Econometrics Framework: Implications for the U.S. - Japan Beef Market Access Agreement.

Redacted for Privacy

Abstract Approved by: _____

Mike V. Martin

The success of the U.S. government in persuading Japan to liberalize the beef market is viewed as a relief to the U.S. beef industry. The economic benefit (to the U.S. beef producers!) of the trade liberalization however is yet to be seen. The size of this benefit is determined, among others, by (a) the net change in Japan's retail price due to the liberalization, (b) the price elasticity of demand for the U.S. beef in Japan, (c) the degree of price rise in the world market, and (d) the export capacity of the domestic sector. Availability of alternative beef sources and the degree of substitutability between the U.S. beef and those alternatives affect factor (b) and factor (d) depends on the extent to

which beef and other meat products substitute each other in the domestic market both in production and consumption. Evaluation of the U.S. - Japan Beef Market Access Agreement (BMAA) therefore has become a high policy profile.

In the interest of assessing possible policy effects of BMAA, several researchers have attempted to parameterize and quantify the Japanese demand for beef. The fact that this market is (a) semi-isolated from the rest of the world by restrictive import quota, (b) managed domestically by government parastatal, and (c) characterized by multi- and intensely differentiated beef with no parallel historical data has made the choice of economic theory and methodology difficult. While most researchers (Group 1) relied on conventional method [e.g. 55; 125], others (Group 2) [2] contend that managed import market may better be explained by a model of political nature. By assuming the usual competitive market behavior, Group 1 underestimates possible implications of existing market structure for building and estimating conventional econometric models. Group 2, on the other hand, limits itself to normative analysis. Due to the absence of consensus among researchers regarding implications of policy-relevant parameters, the desirability of the BMAA is still an unsettled policy issue.

The general purpose of this study has been to generate some further information on Japan's beef market. In pursuant of this objective, an attempt is made to (a) show how significant the beef quality issue is in evaluating that

market, (b) test the market equilibrium hypothesis, and (c) upon the acceptance of the alternative (disequilibrium) hypothesis, estimate the structural parameters from a model specified in the light of imperfections in the market. This fills the void in previous studies.

Drawing on existing literature, the beef quality categories are shown to have been narrowing and, in fact, converging to the two middle categories, medium and common grades. It is suggested that future market studies may benefit from concentrating on these two grades in assessing competitiveness and substitutability with domestic beef. Understanding the nature of this convergence (i.e whether the shift is attributable to changes in cost or preference structure) may contribute to sound policy making.

Based on (a) increased concentration in production and distribution sectors, (b) government intervention in beef and related markets, (c) high degree heterogeneity in beef, and (d) short-run supply inflexibility due to long fattening period and restrictive import policy, the Japanese beef market was hypothesized to have been in disequilibria due to incomplete market information. In testing this hypothesis, two data sets were used -Statistical Yearbook and the Family Income and Expenditure Survey. For reference purposes, they are referred to as Market I and Market II respectively.

The equilibrium hypothesis was tested for uniform and upward and downward differential adjustment speeds. The uniform adjustment rate estimated from the reduced form price

equation supports the hypothesis in both markets. The structural equations were then adjusted in the light of the imperfections in the market and structural parameters estimated using non-linear three stage least squares.

Both upward and downward adjustment speeds in Market I suggest perfect flexibility in prices on annual basis. In Market II, prices are found to have been flexible downward but rigid otherwise. The upward rigidity in prices suggest excess demand. Perfect flexibility in prices on annual basis however may not suggest market equilibrium in a period less than a year.

Consumers are found to be more price responsive than in previous studies implying a greater response of the demand for beef imports to changes in prices due to the liberalization than envisaged by previous studies. The demand for beef however is income inelastic suggesting a partial offsetting in the incremental demand for imports. Finally, consumers respond to changes in beef retail prices by consuming less fish and poultry.

The Japanese Beef Market in a Disequilibrium Econometrics Framework: Implications for the U.S. - Japan Beef Market Access Agreement

By

Berhanu Anteneh

A THESIS

Submitted to

Oregon State University

in partial fulfillment of

the requirements for the

degree of

Master of Science

Completed September 28, 1990

Commencement September 1990

APPROVED:

Redacted for Privacy

Professor of Agricultural and Resource Economics in charge of major

Redacted for Privacy

Head of Department of Agricultural and Resource Economics

Redacted for Privacy

Dean of Graduate School

Date Thesis is Presented: September, 1990

Typed by Berhanu Anteneh for Berhanu Anteneh

ACKNOWLEDGMENTS

It is my great pleasure to have the opportunity to express my sincere gratitude and appreciation to:

a) Professor Mike Martin who, as major professor, initiated interest in the project, continued his qualitative intellectual guidance, constructive suggestions, and generous assistance throughout the development of the thesis. His patience and vitalizing smile also have substantial input.

b) Professor Gene Nelson, ex Department Head, whose generous financial support gave me the courage and energy to pursue the task to the end.

c) Professors Richard Johnston and Steve Buccola who, as members of my Graduate Committee, showed genuine interest and made constructive suggestions.

d) Professor Vic Tremblay, Head of Economics Department, and Professor Peter Ballerstedt of Department of Crop Science, who, respectively as member and Graduate School Representative, showed genuine interest in the subject and their insightful suggestions.

e) Dr. Ali Emami, faculty in the Department of Agricultural and Resource Economics, who both as a friend and great teacher showed genuine concern and interest in the project. His material and provoking intellectual input has substantially contributed to the development and improvement of the work.

TABLE OF CONTENTS

LIST OF FIGURES

Figure No.

LIST OF TABLES

THE JAPANESE BEEF MARKET IN A DISEQUILIBRIUM ECONOMETRICS FRAMEWORK: IMPLICATIONS FOR THE U.S. - JAPAN BEEF MARKET ACCESS AGREEMENT

CHAPTER 1

INTRODUCTION

1.1 Background

The annual per capita meat consumption in the United States (U.S.) appears to have stabilized at just over 117 kg [89, p. 99]. Shifts in its composition however have been apparent over the last two decades. Several researchers [26; 27; 36; 62, p. 140; 80, p. 9; 92; 97, p. 67; 107, p. 754; 109, p. 16-9; 134] have consistently reported that per capita beef consumption has trended down since the mid 1970s. Between 1976 and 1987 alone, it declined by nineteen percentage points [62]. Over a longer period [1953 - 1983], the early 1980s beef consumption per capita was only 11% higher than its level in the 1950s while poultry (chicken and turkey) consumption more than doubled. Major shifts occurred between the 1970s and early 80s during which beef consumption declined by 10% while that of pork and poultry increased by 7 and 21% respectively [62]. Purcell [109] observed a possible stabilization at the 1987-87 level. Future consumption

increases, however, appear unlikely.

After realizing the declining domestic beef demand, U.S. beef producers launch their efforts to halt or even reverse this trend. In the domestic market, they have intensified research in product development and sales of branded new beef products [12; 86, p. 221; 109]. Furthermore, efforts to develop markets have been extended beyond national boundaries.

The expanding demand for beef in Japan due to economic growth, westernization of the diet [37; 52; 82, p. 9; 115], limited domestic production, and restricted import supply, has resulted in high consumer prices [10; 51; 97; 122]. Japan therefore offers an attractive market for the U.S. beef. Accordingly, promotional activities such as product exhibitions [67, p. 13; 72; 82, p. 49] have centered around this market. However, success has not been easy due to the protective beef import policy, mainly quota and tariff.

In support of beef producers, the U.S. government along with Australia (the other major beef exporter to Japan) have been engaged in intensive negotiations with Japan to liberalize that market. After long negotiations, Japan agreed to "liberalize" the beef market by April, 1991. According to the terms of agreement, a 70% tariff rate will, first, replace the quota. Then, this rate is to decline within two years to its "freezing" point, fifty per cent.

1.2 Problem Statement

Parallel to the trade negotiations, there have been several analytical efforts on the part of economists to assess the desirability of the trade liberalization from the U.S. perspective [2; 3; 49; 79; 80; 117; 126; 127; 128; 131]. All but Alston et al [2;3] used the conventional econometric[1] method (Approach 1) to analyze the market and predict possible consequences of the intended trade liberalization to the U.S. beef sector. The use of conventional econometrics apparently presupposes consistency between demanders' and suppliers' desires, i.e. market equilibria. Attempts have been made to identify and characterize market segments (including both domestic and imported beef) and trace consumers' preference structure, i.e. product substitutability. However, achievements have been limited and results mixed. Most researchers predict an increase both in total beef imports and the U.S. market share due to the liberalization [30; 49; 117; 127; 128]. Others do not agree with the rise in the market share [79]. Alston et al [2; 3] questioned the reliability of estimated parameters from conventional econometric models on two grounds (Approach 2). First, despite the highly heterogeneized beef industry, the annual data used in the analyses are not sufficiently disaggregated to permit the computation of relevant cross-price elasticities. Second, one cannot be certain whether the data generated from such

policy distorted market reflect consumers' or middlemen's decisions [2, p.10].

Furthermore, attributing the recently rising U.S. market share to political favoritism[2], Alston et al [2; 3] also advise U.S. policy makers to give up the liberalization drive. To substantiate further their argument, they make use of other studies [49; 122; 128] and a compound annual growth rate in beef imports from the U.S. to predict a continued growth in U.S. beef exports to Japan under the current quota restrained conditions. However, due to varied parameter estimates (Appendix 1) and subsequent incongruous policy implications, the desirability of the U.S. - Japan Beef Market Access Agreement is yet unsettled policy issue.

In this study, we pursue the second contention further but instead using the disequilibrium approach to econometric estimation. First, a disequilibrium hypothesis (about Japan's beef market) is advanced. Second, failure to reject this hypothesis at a reasonable probability level is shown to render conventional econometric model inappropriate. To begin with, we define market disequilibria to mean situations where demanders' or suppliers' desired quantities are not transacted at prevailing prices. This means that observed prices are not associated with the corresponding market clearing identity and the market is in neither competitive (pareto efficient) nor non-competitive equilibrium. This implies inconsistency between agents' (demanders' and

suppliers') desires. In what follows, the competitive norm is discussed in the context of market equilibrium theory, then arguments are advanced to support the disequilibrium hypothesis.

Market competitiveness hinges on the degree of information usage by agents as conveyed by prices [47; 48]. Under competitive conditions, agents' one-period-ahead expected price forecasts conditional on currently available market information coincide with the intersection of ex ante demand and supply schedules. This in turn suggests, inter alia, (a) pareto optimality, i.e. market efficiency, (b) informational balance and even market power between demanders and suppliers, and (c) unlimited entry into and exit from the market. Prices corresponding to such pareto-efficient markets are themselves efficient.[3]

Counting on the identity between market and price efficiency, therefore, we can identify possible sources of price inefficiency and use them to promote our contention of inefficiency or even disequilibria in the Japanese beef market. Of the numerous factors inducing price inefficiency, incomplete market information, imperfections in related markets, and limited numbers of market agents seem the most likely ones to have caused disequilibria in the Japanese beef market.

Although small by world standards, cattle production in Japan has undergone structural adjustment in both breeds

(wagyu and holstein) and at the breeding and fattening levels. The government has encouraged the development of large-scale feed-lots through subsidized capital and special grants. By 1985, farmers 67% less than their number in 1970, owned 45% more beef cattle (both breeds combined) than in the base year, 1970 [1; 37, p. 31]. Structural adjustment has been faster in the fattening stage and the holstein breed both of which are important component of the beef sector. Such accelerated producer concentration is likely to increase the probability of collusive arrangements and dilute the competitive behavior of information and hence of the cattle market. Possibilities for non-price competition also rise. Similar trends were in effect in the slaughtering, distribution, and retailing sectors.

Trading in specific commodities in Japan is traditionally confined to the descendants of those who had exclusive business rights (Kabunakama). These exclusive trading rights are still in place and nowhere are they better illustrated than in the slaughtering and distribution of meat [82]. This group still directly or indirectly controls a substantial proportion of the processing, distribution and retailing of meat. In this traditional channel, livestock growers sell their cattle to village dealers who in turn sell to large dealers or meat wholesalers. The latter sell the meat to secondary large wholesalers from whom small wholesalers purchase and transfer it to retailers.

This system is criticized because (a) the village cattle dealers have "complete" monopoly over available market information and (b) the whole system is characterized by non-competitive price fixing and effective barriers to entrants [82, p. 143]. Item (a) creates a wedge between producers' and competitive market reservation prices, and item (b) introduces both biases and price variability. The size of the variability depends particularly on agents' risk averse behavior and the strength of the market power.

The intent of developing central and sub-central meat wholesale markets by the Ministry of Agriculture, Forestry and Fisheries (MAFF) was to increase the pricing efficiency of the slaughtering and meat distribution system by loosening the grip of the traditional livestock dealers and/or wholesalers [81]. Livestock growers were told to deliver their cattle directly to the centers and have the carcass auctioned. The effect of this arrangement, however, has been limited for various reasons.

First, the number of centers (10) and sub-centers (16) has been limited and they are of varying size. In 1980, two centers (Tokyo and Osaka) alone accounted for a little less than 40% of beef carcass sold through official outlets. Second, each center, except Osaka, was controlled by a single large wholesaler/retailer. Third, the emergence of meat trade in the form of part-cuts or block meat diverts an increasing proportion of beef from the public outlets (auction sales).

The proportion of block meat in total traded beef increased from only 7% in 1971 to 56% in 1980 [82]. As a result, only a little less than one-third of beef traded in Japan in 1980 passed through the public meat centers. The centers also acquire imported beef from the Livestock Industry Promotion Council (LIPC) at non-competitive prices.

The increasing beef trade in block form, on the other hand, is controlled by five giant processors. The companies either purchase cuts from cooperative and/or local government owned plants or process carcasses in their own plants and deliver directly to retailers. These companies control about 60% of trade in processed beef and 40% of the retail outlets [82]. There is a growing concern among those involved in the beef industry that this fast concentration of market power in the hands of only five giant companies threatens (a) producers (b) traditional traders and (c) pricing efficiency. In response to producers' urging, the MAFF has begun encouraging block meat trade in the public wholesale centers.

Another possible source of market disequilibria is government intervention. Basically the intent of government intervention in markets is to manipulate prices in the interest of political considerations. As part of the basic agricultural policy, raising and stabilizing farm incomes, the LIPC was put in charge of stabilizing beef prices. For about a decade from the amendment of the Price Stabilization of Livestock Products Law in 1966, LIPC was empowered to

purchase a certain proportion of imported beef and place it on the market at times of high prices. Following the loss experienced by domestic beef producers during the 1973 oil crisis, beef was incorporated into the stabilization price-band system in 1975.

Since then, LIPC adjusts supply to keep wholesale prices in two representative central markets, Tokyo and Osaka, within the stabilization band determined by the Ministry of Agriculture, Forestry and Fisheries (MAFF). If Tokyo and Osaka wholesale prices fall below the floor price, then LIPC (a) purchases domestic beef at the base price and place it in stock, and (b) provides financial assistance to authorized private dealers in return for holding their stocks. If wholesale prices in Tokyo and Osaka central markets rise above the ceiling price, LIPC sells domestic and/or imported beef from its stocks.

The Ministry of Agriculture, Forestry and Fisheries determines stabilization bands by formula pricing. Based on the cost of living in the farming community, the formula relates the median of the stabilization band to the seven-year-average official price. Theoretically, therefore, the formula seems to incorporate all economic changes into the price determination mechanism (as are incorporated also into expectations) with consequent improvement in price efficiency.

In practice, however, such price manipulations could well be sources of price inefficiency themselves. First, the

stabilization bands are adjusted once a year, suggesting lagged reflection, if at all, of economic changes in prices. Second, the geographical scope of band determination is restricted to only two central markets (Tokyo and Osaka) representing only 10 to 15% of beef transactions. Third, commodity coverage is limited to only the medium and common grades. Fourth, representativeness of the parity price is questionable.

Interventions, more often than not, tend to have adverse effects on price determination and on price discovery mechanisms, that is once interventions occur, prices aberrate and markets move away from the competitive norm. Prices may (a) shift vertically (bias effect), (b) increase or decrease in variability (stabilization effect), or (c) lose automaticity in adjustment between observations (adjustment effect) [124]. The stabilization policy could have a biasing effect as far as the parity price deviates from the competitive one. Depending on (a) the size of the standard error used in band determination relative to the minimum variability under competitive conditions, (b) the speed of response of LIPC to price signals in terms of supply adjustment, and (c) the effect of the policy itself on agents' expectations (e.g. risk averse behavior), variability in prices should have increased or decreased due to the stabilization policy. Contingent on the degree of spatial price integration, policy effects in Tokyo and Osaka wholesale

markets might have had spillover effects on (a) prices of same products in other regions, and (b) prices in other related markets [43]. If commodity prices are integrated across markets, prices of beef other than medium and common grades may have been influenced by the stabilization policy.

Furthermore, the pork sector has been under the stabilization policy since 1961 [82; 105]. If policy intervention has had a disequilibriating effect on the pork sector, excess demand should have affected the beef market also [17; 43; 46]. Finally, price premia due to differentiation provide a basis by which consumers differ in their expectation formation [113].

Virtually all abattoirs in Japan get their cattle from feed lots. The fattening period in Japan is also longer than that in other industrialized nations [37, p.38], implying rigidity in short-run supply adjustment in response to developments in market conditions. If the demand for a particular grade shifts due to an exogenous factor and stock levels cannot fill the gap (assuming that consumers have adjusted their reservation prices to the new condition), and if immediate quantity adjustment on the supply side is difficult, the market will be in disequilibrium [105].

In summary, we contend that (a) increased concentration in both production and distribution sectors, (b) government intervention in beef and related markets, (c) high degree heterogeneity in beef, and (d) consumers' preference for

highly marbled beef (implying a longer feeding period and hence short-run supply inflexibility) could well affect the rate of information flow. If such rates are different for demanders and suppliers, their reservation prices essentially differ from each other and either one or both deviate from the competitive price and so do quantities since they are based on the distribution of expected prices [7], resulting in a disequilibrium market condition.

1.3 Objectives and Methodology

Innes and Rausser [63] indicate that when markets are incomplete, better policy decision requires that the perfect market implications of agricultural policy be reassessed in the light of real world imperfections. The general purpose of this study is, therefore, to reconsider the Japanese beef market in a disequilibrium context and promote its understanding by U.S. policy makers and those who are directly or indirectly involved in the U. S. - Japan beef trade issue. Specific objectives include:

(a) Delineating the dimension and intensity of product differentiation in the beef industry,

(b) Outlining theoretical issues supposed to be pertinent in understanding the Japanese beef export market,

(c) Testing the equilibrium hypothesis of the market and

measuring the degree of disequilibria, and

(d) Upon accepting the alternative (disequilibrium) hypothesis, specifying the structural equations and estimating underlying parameters under disequilibrium econometric framework.

Drawing on existing literature [1; 82; 93; 94; 96; 116; 120], beef quality categories are presented and price premia are used to show the intensity of product differentiation. Theoretic issues pertinent to demand and export market analysis are outlined on theoretical grounds. The demand/supply functions are then derived from utility/profit maximizing behavior [25; 32; 56]. These functions are assumed to be monotonic and twice differentiable. Bowden's [18; 19] partial adjustment model is used to respecify the model to fit the disequilibrium hypothesis. Finally, parameters are estimated and hypotheses tested in accordance with the pioneering literatures on disequilibrium econometrics [5; 38].

1.4 Paper Structure

Recent empirical studies on Japan's beef market are reviewed in the next chapter. Levels and trends in production and consumption of beef in Japan and in its import dependency ratio are outlined in chapter 3. Also considered in this chapter are (a) dimension and intensity of beef quality, and (b) theoretical issues regarding demand and export market

analysis. In chapter 4, following the discussion of conceptual and methodological issues, the empirical model is developed. Analytical results are discussed in chapter 5 and the paper is concluded with a discussion of conclusions, implications, limitations and suggested future research problem areas in chapter 6.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Empirical Studies on the U.S. - Japan Beef Market Access Agreement (BMAA)

Both before and after the 1987 U.S. - Japan BMAA, attempts have been made to estimate the probable effects of the intended liberalization and eventually assess its desirability from the U.S. perspective. The purpose of these policy analyses has been to enlighten U.S. policy makers and beef producers on all possible effects of this Agreement. Policy makers' awareness of such effects has two advantages - it helps them make rational decisions (on other subsequent policy issues) and design a means by which private decision makers can be assisted in their adjustment to the new policy regime [110; 130]. Specific issues addressed include identification of interest groups, econometric modeling of Japan's beef and related sectors, estimation of policy relevant parameters (elasticities), and prediction of probable effects of the intended trade liberalization.

It is often noted in the literature that despite the high level protection of Japan's beef producers [10], the country becomes more dependent on imports [Table 3.2]. Australia, U.S. and New Zealand are the traditional beef suppliers to Japan. Australia alone used to supply more than 60% of Japan's demand

for beef imports [54].

In recent years, a larger proportion of quota increases were allocated to the high-quality (grain-fed) beef [2; 3; 79]. Because the U.S. has comparative advantage in supplying grain-fed beef [82], much of the increase in beef imports after 1980 comes from the United States. United States' share in total beef imports into Japan, therefore, increased from 19% in 1980 to 39% in 1987. Over the same period, Australia's share of the market dropped from 76% to 57%.

The rapid increase in the U.S. share of the market under the current policy regime has provided support for arguments against the liberalization. Alston et al [2; 3] employed a political economy model to illustrate the "comparative advantage" of the existing quota arrangement over the liberalization. Comparing government predictions under liberalization and extrapolations from fitted line, they come to a conclusion that the current quota arrangement is, at least, as good as the liberalization. Alston et al support their argument, i.e. giving up the liberalization drive, with the complaints by the government of Australia about Japan's favoritism in quota administration.

Available empirical studies [79; 80; 122; 127; 128; 131] however argue for the liberalization. Empirical results of recent studies are summarized in Appendix 1. Lin et al [79] employed a market share model (not reported in the Appendix) to estimate the responsiveness of the market share of each

major exporting country to a change in its own cif (cost, insurance and freight) price, competitors' price, share of high-quality beef in total imports, and a one period lagged market share variable. The analysis suggests an increase in U.S. exports to Japan but a decline in the market share. These results are consistent with those of Harris et al's [49].

A demand function for beef imports was estimated, in the same study (Models 1 & 2 in the Appendix), from quarterly data (2^{nd} quarter of 1978 to same quarter of 1987). To avoid exceptionally high income and low own-price elasticities obtained from the first model, the model was re-estimated with the income elasticity restricted to 1.9 (Model 2).

In another study, Lin et al [80], three demand functions are estimated, one for each of holstein (Model 3), wagyu (Model 4) and imported (Model 5) beef. In all models, imported beef is on primal cut basis and is defined to include imports from all sources. It is not however clear whether all products (e.g.diaphragm) are included. Wagyu and holstein beef are on carcass weight basis and have their conventional definition. Average wholesale prices deflated by consumer price indices were used.

All the equations are quantity dependent and are estimated using single equation technique with double log functional form. Most coefficients are statistically significant at the 5% level (t-values in brackets). The

income elasticities are high and significant in all models including that of wagyu. Surprisingly, demand for wagyu beef is also found to be price-elastic (Model 4). Both the high income and price elasticities for wagyu are not consistent with Longworth's [82] intuitive explanation and an historical observations [122]. Longworth argues that for lack of close substitutes, the demand for wagyu beef is insensitive to price changes. Furthermore, despite the declining trend in real retail prices, Teal et al [122, pp. 14-5], per capita high-quality beef consumption in Japan remained almost constant over the period 1965 - 85 (see also price elasticity, Model 7). Over the same period, per capita real income in Japan increased by a factor of 8.4 [64] but failed to put an upward pressure on the consumption of high-quality beef supporting Longworth's intuitive approximations and Teal's observations.

Teal et al [122] estimated four consumption functions. Predetermined variables and definitions are the same across the models. The single equation technique is used to estimate the first three. To circumvent multicollinearity, first differencing is used with the log-log form. Low-quality beef retail prices[4] are used as a proxy for total beef prices (Model 6). Beef consumption is found to be both price and income elastic. Coefficients for substitutes (pork, chicken and fish) have the expected sign but poultry does not seem to compete with beef.

The disaggregated (high- and low-quality beef) models (7

& 8) show that income and prices do not have statistically detectable effect on high-quality beef consumption supporting Longworth's [82] intuitive approximations. Low-quality beef consumption is sensitive both to income and price changes. Pork competes more with high than with low quality beef. When the demand for total beef is specified as almost ideal demand system (AIDS) [31; 32], beef consumption was found to be price inelastic (Model 9).

Analogously, Wahl et al [127; 128] developed an econometric model of the Japanese livestock and meat sectors. Disaggregating beef into two products (wagyu and import-quality), a linear approximation/almost ideal demand system (LA/AIDS) was estimated (Models 10 and 11) [55; 126; 127]. The simulation of policy alternatives using this model forecasts both total beef imports and U.S. share of the market to rise.

Der Sluis and Hayes [117] developed a two commodity (beef and feed grain) and three country (U.S., Australia and New Zealand) model allowing both substitutability and complementarity in demand and supply functions. The model predicts a rise both in total beef imports and the U.S. share of the Japanese beef export market.

Williams [131] considers policy alternatives to quota restrictions and to immediate liberalization in the interest of indentifying a policy that meets both consumers' (increased imports) and producers' (minimal competition) objectives. The

livestock, pork and chicken sectors were modeled econometrically and simulated over the decade 1972 - 1982. The empirical results suggest that Japan's beef imports would have been higher under any other policy than under the quota system. This was a reiteration of Hayami's [51] conclusion. Further comparisons and discussions of elasticities of demand for beef in Japan are available in Teal et al [122] and Dyck [35].

Disparities between parameter estimates from different models are apparent. These essentially translate to different predictions of the probable effects of the beef trade liberalization on the U.S. beef exports and the corresponding market share. Such differences are usually explained in terms of differences in variable definitions, specification and measurement errors. Particularly the heterogeneity of beef in Japan has made the data prone to definitional problems.

Another possible source of disparity is the attempt by researchers to modify prices to fit their definition of quantity variables. In addition, there is no uniformity in selecting price series. Some researchers, e.g. Lin et al, use wholesale prices while others, e.g. Teal et al, use retail price series. Which series of prices embody consumers' decision is not clear.

It is argued in this study that neither series sufficiently reflects consumers' opinion. Instead we hypothesize that because of government intervention both in

beef and related markets, increasing concentration in livestock production and distribution sub-sectors, and heterogeneized beef output, the market has been in a disequilibrium condition. By requiring agents to pursue established marketing chains and procedures, the intervention could delay the flow of information. Similarly, the existing distribution system is such that market information has to pass through a number of decision stations before it reaches end users, i.e. consumers and/or producers. In fact it is reported [82] that market information is controlled by wholesalers and village livestock dealers. Furthermore, the large number of market segments and declining number of market participants at every market level could be expected to further delay information flow. If this is true, price adjustments are partial and consumers' and producers' desires will not be consistent to each other.

It is the prime purpose of the study to test this hypothesis using recent developments in econometric methods, specifically disequilibrium econometrics. An attempt is not made to test each market segment since if we were to do so, we would be faced with same set of problems as previous researchers regarding the price and quantity data. Instead we analyze the market for total beef and hope that, since conditions have generally been common to all market segments, past market conditions for each segment can be inferred from observations on the general market.

CHAPTER 3

BEEF IN JAPAN

There are three sections in this chapter. The historical trends in production and consumption of beef in Japan and its import dependency are considered in the first section. The dimension and intensity of product differentiation in the Japanese beef market are discussed in section two. Theoretical issues pertinent to (a) demand analysis in segmented markets and (b) international trade policy evaluation are outlined in the last section.

3.1 Production, Consumption and Imports

It is commonly accepted that Japanese derive a larger proportion of their animal protein from marine products. Recent trends however show a growing share of animal products in their protein intake [1; 37, p. 5; 82, p. 16]. Virtually all Japanese demand for meat is met by pork, chicken and beef, a little more than two-fifth coming from pork. Of the 1985-87 average per capita consumption, 96% comes from these animals [89, p. 16]. Table 3.1 depicts per capita consumption of meat (total and by animal origin) over the period 1960 - 1984. Over this period, total meat consumption increased by an annual average rate of 7.3%.[5] Individual meat consumption increased at different rates with beef

attaining the lowest, albeit high on its own (383% increase in 1984 relative to 1960). This inferior growth in beef consumption may be explained in terms of differences in firm profitability of the different animal species. The relatively higher cost of production in the beef industry has shifted relative prices in favor of pork and chicken [54, p.44].

Table 3.1

Meat Consumption in Japan, 1960 - 1984.

Product	Consumption (lbs/person)		Annual growth rate,%	Per cent share in total		
	1960	1984	1960-84	1960	1980	1984
Beef	3.5	13.4	5.5	29.4	17.2	19.4
Pork	4.8	31.2	7.8	40.3	49.1	45.2
Chicken	3.6	24.4	8.0	30.3	33.8	35.4
Total	11.9	69.0	7.3	100.0	100.0	100.0

Source: [20], Table 2.

The differential rates essentially resulted in a change in the composition of total meat consumption. Over the whole period, pork and chicken consumption increased at the expense of beef. Later (first half of the 1980s), while chicken consumption continued to rise, pork lost its market share to beef and chicken. Dietary structural shifts, increased beef

supply (both domestic and imported), and increased consumer income may explain this recent shift towards beef. Of the 3.9% market share lost to beef and chicken, about 56% was captured by the former.

Japan's demand for meat is met by both domestic production and imports. Due to scarcity in production factors particularly land and feed, domestic beef production grows sluggishly relative to demand. The growing indigenous supply deficit has opened up a broad way for increased imports. Consequently the nation's self-sufficiency ratio (domestic production/total consumption, including imports,[6] over the same year) in beef declined substantially [Table 3.2).

Over the period 1960 - 87, domestic beef output increased by an average annual rate of 5% while imports grew over the same period by more than three-fold. Both production and imports grew much faster in the 1960's than in any other period considered. Prior to 1960s, Japan's agricultural policy emphasized rice production with little or no attention to the livestock sector. In response to the changing demand structure, the government of Japan enacted what is known as a Basic Law in 1961. This Law gives more emphasis to the livestock sector. The relatively high growth of beef in the 1960s was a result of this policy which might have helped draw idle resources and/or divert resources from other production activities [82, pp. 23-33].

Because of the unsuitable environment for diversified cereal-pasture-livestock farming, Japan's livestock policy paid more attention to animals which can respond better to the growing demand for meat. The biological superiority of pigs

Table 3.2

Imports' Share in Japan's Beef Supply, 1960 - 87.

Year	Domestic Production	Imports *	Imports' share in consumption	Self-sufficiency ratio
	----- 1000 tons ------		---- Per cent ----	
1960	142.4	5.8	3.9	96.1
1970	278.0	33.2	11.7	89.3
1980	418.1	173.7	29.3	70.7
1987	564.9	311.3	35.5	64.5
Annual growth rates (%)				
1960 - 1987	5.0	15.3	-	
1960 - 1970	6.3	17.2	-	
1970 - 1980	3.8	16.2	-	
1980 - 1987	3.8	7.6	-	

* Including edible offals
Sources: [1, p. 10; 82, p.31; 89, pp.30, 67]

and poultry to cattle in terms of feed efficiency, litter size, growing period and carcass ratio (dressingout

percentage), worked against cattle development. Accordingly, despite the renewed spirit of the Basic Law in 1969 [82, p. 30] to enhance further growth in the livestock sector, beef production after 1970 could not expand as fast as in the 1960s [82, pp. 31-33].

Demand for beef, on the other hand, continued to grow through the 1970's allowing imports to grow by about the same rate as in the 1960s [Table 3.2]. The then weak power (limited only to ceasing selling imported beef when prices are on a decline) [82, p. 172] of the Livestock Industry Promotion Council (LIPC) also left imports relatively unchecked. In 1975, LIPC was empowered to buy and sell even domestic output, and its quota share of imports was increased to more than 80% of total import quota [82, p. 182]. Consequently, imports in the 1980's cease paralleling the growing demand for beef.

Much of the increase in Japan's beef imports after 1980 comes from the U.S. whose share in that market increased from 19% in 1980 to 39% in 1987. Australia's share over the same period declined from 76% to 55% [97, p. 4]. Attribution of changes in beef imports over the period 1980 - 87 to value and volume effects revealed that 64% [7] of the increase is quantity induced. This implies that Japan's import demand is by and large autonomous or probably income motivated. Some authors [2; 3; 93] attribute the shift from Australia to the U.S., as source of beef imports, to political favoritism. Others [79] contend that U.S.'s increased competitiveness also explain

part of the shift.

3.2 The Beef Quality Spectrum in Japan

3.2.1 The Need and Purpose of Grading

To alleviate the inefficiency inherent in the traditional slaughtering and meat distribution system, beef grading was introduced three years after the establishment of the first public wholesale meat center,[8] Osaka, in 1958. Grading was introduced to facilitate marketing through (a) conveying more information on the essential characteristics of meat products to consumers and (b) transmitting such information more quickly than the traditional system. To reflect consumers preference, grading is based largely on the degree of marbling [1; 82; 93, p.214]. The grading standards were reviewed in 1963, 1970 and 1975.[9] Due to continued purpose and criteria of grading however, changes within and hence between grade categories have been marginal [82, p.162]. Due to its increasing share in total beef supply, imported beef did not escape the grading scheme. In what follows, we give an account of beef differentiation in Japan - first domestic and then imported.

3.2.2 Domestic Beef

It is unanimously reported that there are six grade categories [1, p.8; 82, p. 162; 93; 94; 96; 116; 120]. The identification however varies from one author to another. Table 3.3 summarizes the different labellings attached to each grade category by source.

The first column [Table 3.3] contains grade labellings reported by Longworth [82, pp. 162, 166] as existed in Japan's beef market while the second column reflects his generalizations of the market segments. Soken's [120] have no essential difference from Longworth's market segments indicated in the second column.

The beef that falls under utility category originates in most part, from cull dairy cows and is consumed either in production points or destined to processing. The kobe (supreme plus superior), on the other hand, comes from few highly marbled wagyu cattle. Longworth then puts the balance into two categories - high-quality and popular. The best of wagyu carcass that does not achieve super status, the top quality of the holstein carcass and imported high-quality (grain-fed) beef fall under the high-quality (HQ) category. The popular category on the other hand,

Table 3.3

Beef Quality Categories in Japanese Market

Longworth, '83		APRC, (s.d.) and Simpson, '85	Mori and Gorman, '85, '87, '89	Soken, '87
I	II			
Super Choice	Kobe/ Super	Supreme Superior	Supreme Superior	Supreme Superior
1st grade	HQ*	Excellent	1st grade	HQ*
2nd grade		Medium	2nd grade	Popular
3rd grade		Common	3rd grade	
Utility	Processing	Utility	Utility	Processing

* HQ = high quality

Note: Simpson and Soken - quoted in [72, pp. 8 and 10 respectively]

consists of a larger proportion of the holstein beef (2nd and 3rd grades) and grass-fed beef. This leaves the HQ category to match with the 1st grade. There is no disagreement among authors on this definition [see for example 72, p. 10].

The grading system does not distinguish grades on the basis of breed and sex. Longworth [82, pp. 80, 110, 166] however breaks the information down into four further categories within each grade - two breeds (wagyu and holstein) and two sexes within each breed. Information along this line is also available elsewhere [e.g. 1, p. 8] indicating probably that market agents are using the information on breed and sex in their decision making.

Table 3.4

Total and Graded Beef Distribution by Breed and Sex

Item	1971	1976	1981	1984
Grand total (1000 tons)	289.7	295.4	468.3	529.8
Share of: (%)				
- Wagyu in total	54.8	43.7	28.7	36.3
. Females in Wagyu	52.7	45.6	37.8	45.5
. Steers in Wagyu	42.8	50.9	61.0	53.6
- Holstein in total	45.2	56.3	71.3	63.6
. Females in holstein	76.2	55.1	48.4	48.5
. Steers in holstein	23.8	44.9	51.6	51.5
Proportion graded: (%)				
- Of total	22.8	33.8	45.4	na
- Wagyu in graded	52.1	46.4	31.3	44.2
. Females in graded	28.5	19.5	9.6	19.4
. Steers in graded	23.7	27.0	21.6	24.8
- Holstein in graded	47.9	53.6	68.8	55.8
. Females in graded	35.4	27.3	31.3	30.7
. Steers in graded	12.5	26.3	37.5	25.1

Source: Computed from [82, pp. 80, 110, 166], and [1, pp. 8, 10]
na = Not available

A look at the trends overtime in the contribution of each breed by sex to total beef output and graded carcass is worthnoting. Such information is summarized in Table 3.4. The proportion of beef graded has remained well below 50%. In 1981, only 45% of total beef output was graded. This was 5% above the 1980 level. Wagyu is losing its share of both total and graded output to holstein beef. Longworth has ascribed

this decline to poor reproduction rates, limited feeder-calf supply and high cost of fattening relative to holstein cattle. Holstein's share in total output increases from 45% in 1971 to 64% in 1984 with a parallel rise in its share of graded beef from 48% to 56% over the same period. By 1987, the share in total output increased to 68% [89].

Beef production from steers has increasingly dominated female beef in both breeds. The change in wagyu's and holstein's relative share of graded beef arises from declining wagyu females' and increasing holstein steers' shares.[10] The increased share of holtein steers has more than compensated the decline in holstein females' share due to their increased retention for future milking [82, p. 125].

Graded beef for selected years is distributed among grade categories [Table 3.5]. The years reported are selected on the basis of data availability. Breed differences are retained in constructing this table to shed some light on the proportion of each breed destined to each of the grade categories. One canobserve that despite the traditional belief[11], [82, p.20], Wagyu beef forms the majority of the medium grade beef. This is also consistent with Khan and Ramaswami [72, p.9] who reported that, in 1984, of the wagyu steers graded, only 14% reached the excellent grade while 47 and 33% were graded as medium and common respectively. Of the six categories, the top two (Kobe = Supreme + superior) account for only negligible (< 5%) proportion of graded

domestic beef. Furthermore, the proportion of graded beef formed by kobe declines over time. Over a decade alone (1971 - 1981), this percentage decreased by 50%.

According to Mori and Gorman [93], the Ministry of Agriculture, Forestry and Fisheries is committed to increase net returns to family labor. One way of achieving this objective without taxing consumers is reducing production cost. Since Japan is import dependent for its feed supply, shortening the feeding period is considered as a major means of reducing cost. In fact, the MAFF is said to have launched a nation-wide campaign to shorten feeding period. This discourages the production of highly marbled beef such as kobe.

Virtually all beef under excellent (1^{st} grade) category originates from wagyu beef. Nevertheless, despite increased grading over time, the share of 1^{st} grade beef in graded domestic beef fell by 67% over the decade 1971 - 1981. The lowest quality category, utility, has a constant (around 10%) trend in terms of its share in total graded domestic beef output. Almost all utility beef comes from the holstein cattle.

The dynamics of the Japanese beef market therefore has been related to the two middle quality categories, medium and common. These are also respectively known as 2^{nd} and 3^{rd} grades. Most of graded wagyu beef falls under medium followed by excellent grade. In the early 1980s, common grade

Table 3.5

Per cent Share of Quality Categories in Graded Beef

Grade Category	1971 W	1971 H	1976 W	1976 H	1981 W	1981 H
Supreme	0.5	-	0.8	-	0.5	-
Superior	3.9	-	2.9	0.1	1.6	0.1
Excellent	18.1	0.2	11.3	1.1	6.5	1.3
Medium	25.0	9.9	23.7	18.2	15.5	27.0
Common	4.4	25.2	6.8	24.0	6.6	29.0
Utility	0.5	12.5	0.7	10.1	0.5	11.3

* W = Wagyu and H = Holstein
Source: Computed from Table 3.4.

superseded excellent grade of wagyu beef. While most of the holstein beef used to be categorized as common, the proportion of graded holstein beef qualifying for medium grade is substantially increasing. The data over the decade 1971 - 1981 suggest that almost all increased share of holstein beef in graded domestic output was actualized in the medium grade. By contrast, about 50% decline in the share of wagyu in graded beef over the same period came from excellent and medium grades. This suggests that domestic beef production is becoming less differentiated from imported competitors such as U.S. beef.

3.2.3 Imported Beef

Following Armington [9], Johnson, Grennes and Thursby [69] have constructed demand models where products are differentiated by country of origin. Albeit empirical evidences are immature, the modelers contend that consumers may prefer, say, American beef to Australian, adjusted for price differences, for reasons of convenience in terms of delivery, payments and other services [73]. Branson [22] also argued that importers' desire for secured supply sources (e.g. using reliability as decision criterion over where to import from and purposeful diversification of supply sources) can partly explain why importers prefer products by country of origin.[12] If one accepts this argument, in the face of being traditional exports to Japan, one can expect that beef imports from the U.S., Australia and New Zealand may have their own "distinct" markets in Japan.

Imported beef can also be differentiated based on product form, e.g. frozen, chilled and aged. One other criterion (proxy for product characteristics, say marbling) is type of feed. In this regard, imported beef in Japan has two grades, grain-fed and grass-fed. Over 70% of total beef imports is imported in these forms [122, p. 13]. Virtually all grain-fed beef is exported from the U.S. and is gauged to be superior to the grass-fed beef imported largely from Australia and New Zealand. These three countries supply over 95% of

Japan's beef imports.

3.2.4 Domestic versus Imported Beef

One interesting issue in export market analysis is to develop a general perception about the size (assuming existence is established) of the market for the exportable. This requires investigation of possible effects of the determinants (own price and other demand shifters) on continuity or even possible future expansion of the market. In markets where products (of the same commodity) are differentiated, provided that such grades are distinctly segregated by economic factors, each grade has its own market, i.e. demand and supply schedules with the conventional determinants. Since the products belong to the same commodity, high substitutability among themselves is likely. Prices of substitutes may, therefore, be the primal demand shifters.

Furthermore, both income and price elasticities may differ from market to market (or grade to grade).

Attempts to identify and characterize such market segments in Japan has not been easy however. Although beef is alleged to be highly differentiated product in the market, historical data disaggregated by grades is not available. Aggregated data, on the other hand, contains mixed and probably misleading information. In the absence of knowledge

Table 3.6

Matching of Imported Beef with Domestic Beef Quality Categories

Author	Matching	Reference *
Longworth, 1983	. U.S. HQ beef vs wagyu	Japan's Policy
makers [82]	. U.S. HQ beef vs the best of holstein and wagyu except kobe	Japanese traders
	. Fed frozen HQ U.S. beef vs 1st grade holstein beef	
	. Fed frozen HQ U.S. beef vs kobe	restaurants and hotels
	. Oceania best grass fattened vs 3rd grade holstein	
	. Other imported vs holstein culls	
Gorman and Mori, 1987 [42]	. U.S. fresh chilled vs 3rd grade holstein	
	. U.S. grain-fed prime vs 2nd holstein steer and 3rd grade wagyu	Japan Industry (Probably beef)
	. Australia grass-fed chilled, between 2nd and 3rd grade holstein steers	
	. U.S. HQ vs 2nd holstein	Ohga et al
	. Grass-fed vs holstein culls	Ohga et al
Wahl et al, 1989 [127]	. U.S. choice grain-fed, between medium and common	
	. U.S. choice grass-fed vs common (3rd)	

* Reference refers to those who actually use the classification, i.e. authors' source of information regarding the reported classification. For example, in the eyes of Japanese policy makers, the U.S. high-quality beef is a close substitute for wagyu while traders view same beef to substitute only top quality holstein and lower quality wagyu.

about the components and their interrelations, parameter values estimated from aggregated data need to be subject to suspicion [see for example 58; 59; 60]. Observed inconsistencies in recent opinions and demand studies in matching U. S. beef with domestic beef in Japan are summarized in Table 3.6. In brief, such matching has not yet gained unanimity.

3.2.5 Intensity of Product Differentiation

Following Waugh's [129] exposition of attributes' influence on product prices, product characteristics are hypothesized to influence consumer demand. Proponents of this theory view consumers' demand for quantities as "derived" demand [61; 76; 123], derived from the demand for attributes. Because attributes are contained in products in varying proportions, price premia seem to support this new development in consumer economics. When economic factors (consumers' preference for different product attributes) give rise to price premia, products would be differentiated leading to market segmentation.

The varying proportion of attributes explains not only the existence of differentiation (i.e. imperfect substitutability among products) but also the degree or intensity of differentiation. According to the hedonic price theory, the price of a product is determined by both quantity

and quality-related factors. If one regresses observed prices on a vector of attributes, the effect of each quality factor on the price formation is captured by the corresponding coefficient. The intercept would yield the quantity (adjusted for quality differences)[13] price and hence the fitted value is the price of the product [68; 81; 86; 104; 129; 132; 133]. Since the products belong to the same commodity, substitutability in consumption is most likely. The degree of substitutability however is inversely related with the intensity of differentiation among the products (the knowledge of either is important for policy analysis).

The intensity of differentiation therefore can be measured using either relative prices (price ratios) or cross-price elasticities.[14] Both require that price premia are purely attributed to economic factors, i.e. denote consumers' preference structure. The use of the latter however is inhibited by the absence of price and quantity data on consumption by quality category to estimate the relevant cross-price elasticities. In this study, therefore, relative prices are employed to cast some light on the intensity of product differentiation in the Japanese beef market.

The positive correlation between price premia and degree of differentiation and the inverse correlation between these two on the one hand and substitutability on the other are basic to employing price ratios as measure of degree of differentiation. High price correlations (positive) suggest

Table 3.7

Beef Price Spreads in Japan, 1980 and 1982

Grades	1980				1982			
	Wagyu		Holstein		Wagyu		Holstein	
	F*	S*	F	S	F	S	F	S
	per cent							
Supreme	308	256	328	-	337	263	-	-
Superior	246	225	252	224	263	230	238	-
Excellent	211	198	209	181	225	199	192	178
Medium	173	169	168	149	180	168	156	150
Common	137	135	130	136	137	136	128	136
Utility	100	100	100	100	100	100	100	100
U.S.	156	150	198	184	146	136	171	169
Australia	132	126	168	155	115	107	135	134

* F = Female; S = Steer
Sources: [93, pp. 213, 214]
Note: Import prices are primal cuts' share weighted averages in Kanto area. Original source is Livestock Daily, Journal in Japan.

close substitutability and hence low differentiation and vice versa. With this general understanding, beef wholesale[15] prices in Japan are related to utility (the lowest in the ladder) grade prices [Table 3.7].

Domestic beef prices are given by breed and sex. Only single price (at domestic markets) is considered for imported

beef by country of origin. If prices reflect consumers' grading, the U.S. beef attains common grade relative to wagyu and excellent grade relative to holstein beef. The price differences between the U.S. and Australian beef also seem to support the common view that the former is superior to the latter [42; 117].

These ratios however are contingent on the assumptions underlying product differentiation and hence need be interpreted cautiously. As argued in this paper, the Japanese market is imperfect due to price-support programs and other interventions. Market interventions may dilute the strength of price premia as an indicator of differences in product attributes. Product grading in imperfect markets, for example, may give rise to discriminatory pricing [124]. Consumers' demand is also influenced by non-market factor (excess demand) contributing to differential prices. Market imperfections therefore may cast different implications across market segments tending to change price ratios at given product attribute state. Price premia may also change over time due to supply fluctuations.

3.3 Theoretical Issues

When markets are far from a competitive norm, non-economic factors exert direct and/or indirect influence on agents' decisions. Such effects are well explained in terms

of the market structure, concentration (of producers, distributors or consumers) and product differentiation. The basic premise of this paper is to assess the reflection of these non-economic factors on agents' behavior. Here theoretical considerations pertinent to the Japanese beef demand analysis are outlined.

3.3.1 Market Structure and Demand Analysis

The complex nature of the beef distribution system has been the subject of negotiation [72] between the two governments, the U.S. and Japan. The distortive effect of structural adjustment (concentration in particular) has also been dealt with elsewhere [Chapter 1]. Implications of product differentiation for demand analysis are treated here on theoretical basis.

Demand models incorporating quality aspects are not yet widely used for empirical reasons. Their theoretical dimension is however appealing in understanding consumer behavior in product markets. In economic terms, differentiated products are graded and sorted according to certain attributes, expected palatability for example, [71; 103; 137] related to the final demand , demand for products. This implies that separate but interrelated demand and supply functions exist for each product. Houthakker [61], Lancaster [76] and Theil [123], among others, have proposed demand

models in which consumers' decisions are responsive to product traits. There are also economic reasons for investigating individual functions on their own. First, elasticities may differ from one grade to another. Income elasticities for example are usually high for high grade and low otherwise. Second, the demand for individual grades are more price responsive (since substitutes are plenty) than the demand for their aggregates [124].

We have shown [§ 3.2] that beef in Japan is heterogeneous. As argued above, the heterogeneity reflects diversified consumer preference structure. This implies that changes in economic factors are not equally (and probably simultaneously) manifested in the price data collected on the different quality beef. Then prices change at different rates[16] [121] and Hick's [58; 59; 60] fixed relative price assumption is violated rendering product aggregation unrealistic.

Estimated elasticities from aggregated data, therefore, convey mixed information and are hard to interpret and translate to policy recommendations. Langemeier and Thompson [77] for example have shown that income elasticities for fed beef estimated from aggregate demand for beef are underestimated. Aggregation of products for empirical analysis is suggested to overcome estimation problems and is applicable only under restrictive conditions. Pollak [108] clearly shows the difficulties involved in constructing

individual consumption functions.

Had it not been for data problem, this fact has not been secret to researchers working on the Japanese beef market. Longworth [82, p. 276], for example, pointed out that elasticities vary between submarkets and warned the danger of using estimates from aggregate data. Empirically, Teal et al [122, pp. 14, 33,34] used average and representative prices in two different runs and found different income and price elasticities. They then concluded that estimation of elasticities corresponding to each market segment with the available data would be unrealistic.

The realistic inference from these observations is that to understand the Japanese beef market, each market segment needs to be studied, possibly as part of a multi-market model. Such studies will provide information on important market characteristics such as the size of each market, existing and potential competitors (substitutability), consumers' preference and possibly its potential in the future. Reliable policy recommendations may then emerge from such set of information. The determination of the liberalization policy induced incremental beef exports from U.S. and its sustainability, for example, requires the knowledge of product substitutability in each market (i.e. U.S. products versus other competitors) and U.S. beef producers competitive position relative to other existing and potential exporters.

3.3.2 International Trade

Basically, the demand for imports is determined by the same factors[17] that influence domestic demand for the same product. However, demand for imports is positive[18] only when domestic demand exceeds domestic supply at a given time and space. Put differently, the demand for imports is the difference between what the consumers demanded of a commodity and that domestic producers supplied. This excess demand transcedes national boundary and is confronted by excess supply from exporters.

We illustrate the case using Figure 3.1. Suppose that the commodity under consideration is homogeneous, i.e. there exists near perfect substitutability between domestic product and imports. Imports of different origin are also assumed to substitute each other. This assumption is important in that it permits aggregation of export supplies in the world market.

There are three markets - exporting (Panel a), the international market (Panel b) and importing (Panel c). These respectively represent the rest of the world (RoW) consisting of different exporters including the United States, the world and Japan. Initially, we assume that the two markets (RoW = i and Japan = j) are in autarky conditions with (P^{io}, Q^{io}) and (P^{jo}, Q^{jo}) being the respective autarky equilibrium values in the price - quantity space. Prices in Japan are substantially higher than in the rest of the world.

This price wedge permits trade between the two countries.

Domestic demand and supply in each market respond to the price change in the opposite direction. In Japan, the price decline (a) expands domestic demand for transactions and (b) erodes firms' profitability leading to a down word drift in domestic output. The domestic demand schedule corresponding to prices below P^{jo} corresponds to the excess demand (ED^j) schedule in the world market, (Panel b). The rise in prices in the exporting market (a) induces output and (b) discourages domestic consumption. The incremental output (Q^{io}-Q^{i2}) added to that syphoned from domestic consumption (Q^{i1}-Q^{i2}) yields the excess supply schedule represented by ES^i in the world market. The volume of trade continues to rise until export and import prices are equalized. At this particular price levelneither the exporters nor the importers have an incentive for further transaction. The desire for transactions is balanced at the intersection of excess demand and excess supply schedules in the world market (Panel b) yielding the competitive world price, (P^{w1}).[19] The competitive quantity flow is 0-Q^{w1} (Panel b). This corresponds to Q^{i1} - Q^{i2} (exports) and Q^{j1} - Q^{j2} (imports).

The imposition of quota by Japan at Q^{w2} (Panel b) increases retail prices in Japan to P^{j1}. By the large country assumption, import prices decline to P^{j2} corresponding to the new world price level, P^{w2}. Under the quota policy, the rest of the world exports less (0-Q^{w2}) and at lower prices, P^{w2}.

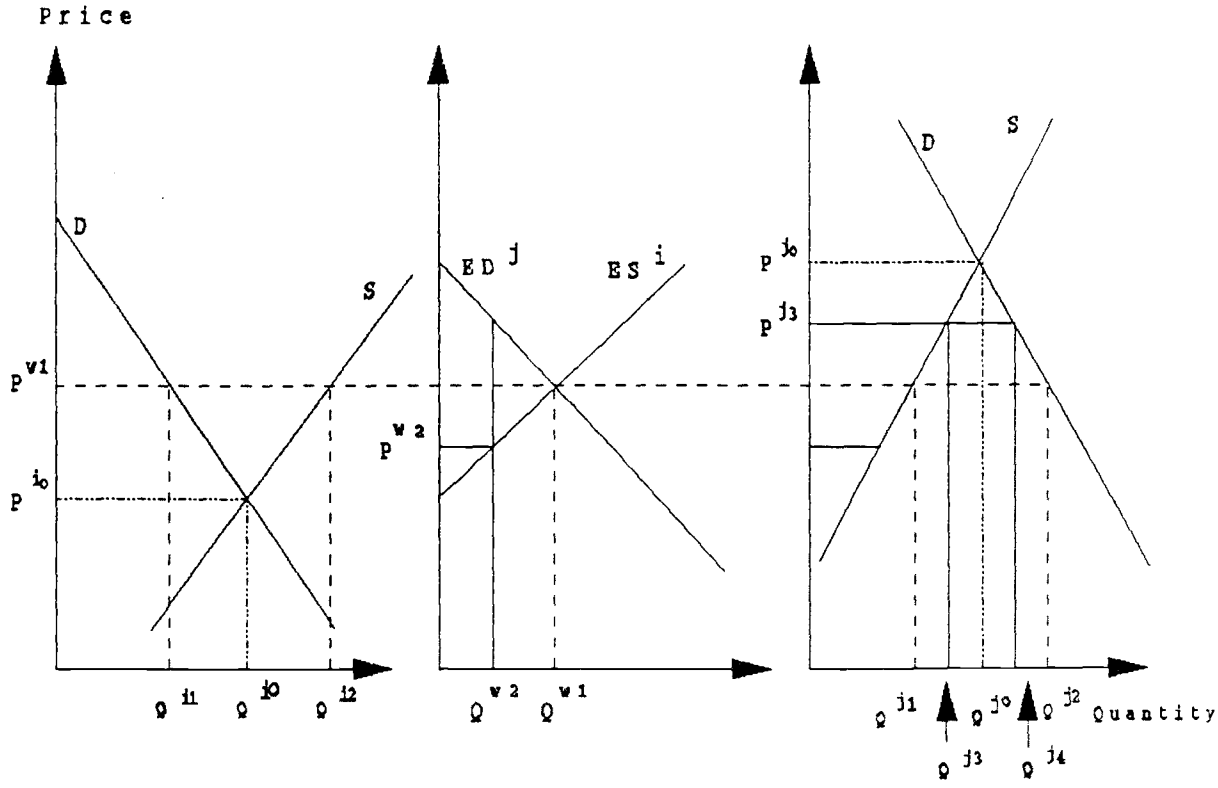

Figure 3.1 The Economics of Quota Removal

The motive for the U.S. - Japan Beef Market Access Agreement is the economic benefit arising from the restoration of the free trade situation. Assuming unlimited excess supply on the relevant range, the size of this benefit depends on (i) the incremental demand for imports, (ii) the extent of price rise in the world market, (iii) the size of the loss in domestic consumers' welfare, and (iv) the net effect of the policy change (trade liberalization) on related sectors. Factor (i) depends on (a) the extent to which retail beef prices in Japan will decline due to the quota removal in 1991 (i.e. the decline in the domestic price due to the quota removal plus a rise in the same price due to the tariff to be imposed), (b) the Marshallian demand price elasticity of beef, (c) the availability of substitutes and (d) the cross-price elasticities.

When the case becomes country-specific, incremental exports (i.e. additional exports over and above the pre-policy change level) from the country, say U.S., become more important than incremental imports. Analogous to the import case, incremental exports depend, inter alia, on (i) the export supply capacity of the domestic economy, (ii) the degree of competition (i.e. substitutability in consumption) between imported beef of different origin in Japan [78], and (iii) movements in relative prices over time. Ardeni [8] and Kravis and Lipsey [73] have shown that the law of one price in the international market does not hold even under product

homogeneity. Substitutability of products in consumption and production[20] in the domestic market limits factor (i). The net benefits from trade accruing to the nation, say U.S, are therefore the weighted sum of losses and benefits across affected sectors, the weights reflecting policy concerns.

CHAPTER 4

ANALYTICAL FRAMEWORK

Albeit disequilibrium economics (e.g. the theory of partial adjustment or stickiness in prices, wages) conceptually began with the Keynesian revolution [106], model specification and estimation out of equilibrium markets in an econometric framework is relatively a new phenomena. After the pioneering article by Fair and Jaffee [38] and subsequent amendments by Amemiya [5], the model has been applied to a number of empirical studies [16; 24; 66; 75; 87; 88; 135; 136].

4.1 The Conceptual Basis

Consider the following market model.

$$[4.1] \quad D_t = \alpha_{m-2} + \alpha_{m-1}P_t + \Sigma\alpha_m X_{mt} + E_{1t}$$

$$[4.2] \quad S_t = \beta_{j-2} + \beta_{j-1}P_t + \Sigma\beta_j Z_{jt} + E_{2t}$$

$$[4.3] \quad D_t = S_t \qquad \text{(Market clearing identity)}$$

$(t = 1, 2, \ldots, N ; m = 2,3,\ldots,k_1 ; \quad j = 2,3,\ldots,k_2)$

where D and S are respectively ex ante quantities demanded and supplied; P is retail price of the product of concern; Xs are the k_1 exogenous and predetermined demand enhancement factors and Zs are the k_2 supply determinants; α_m and β_j's are

parameters to be estimated and E_{it}'s (i = 1, 2) are error terms assumed to be both serially and contemporaneously independent and normally distributed with mean zero and variances σ_{E1}^2 and σ_{E2}^2 respectively and finaly N is the sample size with time index t.

The market equilibrium is attained when demand [4.1] is balanced with supply [4.2]. This is indicated by the market clearing identity, [4.3]. The necessary condition for market clearance is flexibility in price determination to facilitate the immediate reflection of changes in price movers (market forces) in tomorrow's prices. Then a price discovery mechanism that allow agents have easy access to such information ensures that changes in economic information are impounded in the agents' reservation prices. This in turn ensures (a) consistency between consumers and producers' desires, and (b) the persistence of equilibrium conditions. The consistency between agents' desires, on the other hand, signifies that quantities demanded and supplied lie, both individually and simultaneously, on the ex ante demand and supply schedules and price and quantity are single-valued functions of each other. All these conditions combined permit the application of conventional econometric method to estimate the underlying parameters and make statistical inference about the market behavior.

If identity [4.3] does not hold, apparently due to an overt non-competitive behavior, then the market is in a

disequilibrium condition, i.e. does not clear. Under such conditions, (a) agents consider a non-market information (i.e. excess demand) in their expectation formation, and (b) demanders' and suppliers' desires are not consistent to each other. Conventional econometrics is therefore of little help in analyzing data generated from a disequilibrium market largely for the following reasons. First, particularly the inconsistency between agents' desires poses limiting analytical problem on the interpretation of transacted quantities. This means that, at any given time, while in an equilibrium market observed quantities are readily interpretable as quantities demanded and supplied (by virtue of identity [4.3]), such quantities in a disequilibrium market may lie on either the demand or the supply schedule but seldom on both. Second, the conventional econometric model suffers from specification (omitted variable) bias due to the exclusion of the information on excess demand.

These issues are further illustrated using Figure 4.1. In Panel (a) the market always clears by identity [4.3]. This implies that the distribution of price expectations is known to both consumers and producers, i.e. agents use all available current average market information in forming their expectations. Under such circumstances price changes follow a random walk model (provided that the entire probability distribution of price expectations is white noise), i.e. today's price of a good is the conditional expectation of

tomorrow's price.

$$[4.3] \quad P_t = E(P_{t+1} | \Phi_t)$$

where Φ_t is the average available market information at time t and P_t includes all relevant costs required to carry over the product to a future date, say t+1.

This means that agents' successive expectations conditional on currently available market information are orthogonal to each other and this orthogonality in the expectations ensures that price changes (i.e. forecast errors) are unpredictable or patternless. And hence there is no basis for systematic adjustment of agents' behavior.

When this happens to be the case, consumers' and producers' desires are consistent to each other and both individually and simultaneously lie on the ex ante demand and supply curves (this essentially leads to pareto tangencies between indifference/isoquant curves and the corresponding budget constraint lines). Thus observed quantity and price coordinates can be presumed to span over the whole demand/supply curve from the consumers'/producers' perspective in the price-quantity space. This suggests that price is a single-valued function of quantity and vice versa. Then the likelihood function whose sum of squared residuals is to be minimized over the underlying parameters given observed values on endogenous and exogenous variables can be constructed using

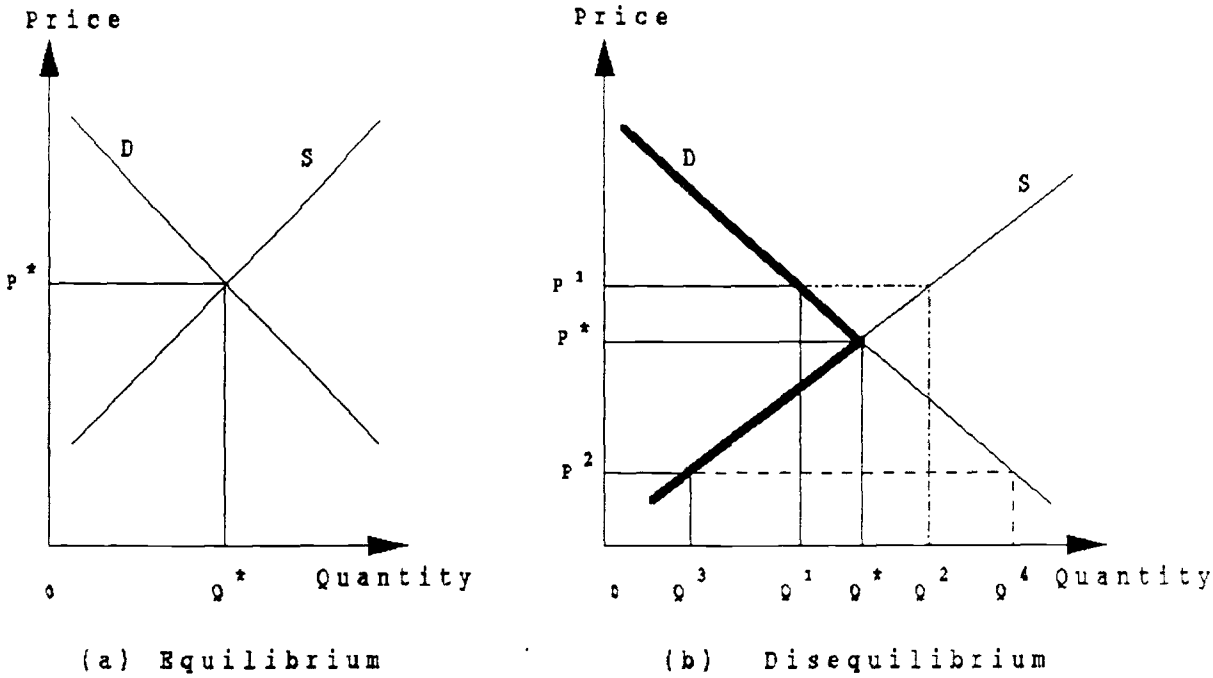

Figure 4.1 The Equilibrium and Disequilibrium Market Model

the assumed single probability density function. The prevalence of single probability law also ensures that the data on the endogenous variables, price and quantity, are generated with joint density functions as required by the standard econometric models.

Panel (b) depicts the disequilibrium condition. Here equations [4.1] and [4.2], the ex ante demand and supply functions respectively, remain intact. But the market is no more clearing and hence identity [4.3] does not hold. This condition posesa problem in interpreting transacted quantities. Clower [28], Grossman [45], and Benassy [13] have shown that (a) iftransactions are voluntary, then transacted quantities are less orequal to the minimum of quantity demanded or supplied, i.e.

$$[4.5] \qquad Q_t \leq \min (D_t , S_t)$$

and (b) if mutually advantageous transactions are exhausted, then transacted quantities are equal to or greater than the minimum of desired demand and supply quantities, i.e.

$$[4.6] \qquad Q_t \geq \min (D_t , S_t)$$

The two conditions combined yield identity [4.7].

$$[4.7] \quad Q_t = \text{Min}(D_t , S_t) \qquad \text{(Minimum condition)}$$

This identity bisects the price-quantity space into two observation regimes on the basis of whether demand exceeds supply (regime 1) or vice versa (regime 2). By virtue of identity [4.7], observed quantities are interpreted to lie on the ex ante supply schedule if they occur in regime 1 and on the ex ante demand schedule otherwise.

The price levels can also be used for classification of observed quantities into these two regimes. If the observed price, P_t, exceeds the ideal market clearing price, P_t^*, then the observed quantity coincides with the ex ante demand by identity [4.7]. Analogously, if the observed price is less than P_t^*, the observed quantity coincides with the ex ante supply. Put differently, at any time-period, say t, either demanders ($P_t^* < P_t$) or suppliers ($P_t^* > P_t$) are on their ex ante curve. Under this situation, there exists a possibility for two price levels to correspond with a single observed quantity. Thus albeit price is a single-valued function of quantity, this does not hold for the reverse. Furthermore, the observed price and quantity data are probably generated with two different probability laws, i.e. not all price-quantity coordinates have joint density functions.

Identity [4.7] also suggests that (a) consumers' and producers' desires are consistent to each other only if the special case, equation [4.8], holds and (b) observed quantity never exceeds identity [4.8] = Q_t^*, i.e. all observed quantities lie to the left of Q_t^*. This obviously truncates

the parameter space.

$$[4.8] \qquad Q_t = D_t = S_t$$

The truncation of the parameter space, the generation of the observed data under different probability laws, the violation of the one-to-one mapping between observed price and quantity data, the exclusion of the information on excess demand and most of all the inconsistencies between consumers' and producers' desires do not render the observed data amenable to conventional analysis. The application of standard econometrics to such a data set is therefore by all counts questionable.

The basic argument is that because the information on excess demand (which has been considered in the agents' decision making process) is excluded, the conventional econometric model suffers from specification (omitted variable) bias. The parameters subsequently estimated from this model will also be biased, i.e. will have the wrong, probably inflated, standard errors and may be even inconsistent. The standard errors will be wrong not only in levels but also, most importantly, may not reflect agents' behavior in which case they become to be misleading policy parameters.

Correct specification of the econometric market model therefore requires to incorporate the information on excess

demand. The inclusion procedure of this information into the econometric model is shown in section 4.3. Here (a) the rationale for using the proposed proxy variable, (δP_t) for excess demand, and (b) implications (or econometric advantages) of including excess demand into the econometric specification are given.

Excess demand (ED_t) is defined as the difference between desired demand (D_t) and supply (S_t) quantities, equation [4.9].

$$[4.9] \quad ED_t = D_t - S_t$$

As usual t is time index. The problem is neither of these desired (ex ante) quantities are observable, that is excess demand itself is unobservable. However under the assumption that market disequilibrium prevails because of stickiness of prices (chapter 1), prices can be presumed to adjust according to equation [4.10].

$$[4.10] \quad P_t - P_{t-1} = \Theta(P_t^* - P_{t-1}) \qquad 0 < \Theta < 1$$

where the P_ts are as defined above and Θ is the price adjustment rate. With the assumption that Θ lies in the open interval (0, 1), price changes ($\delta P_t = P_t - P_{t-1}$) are positive in regime 1 ($P_t^* > P_t$), zero in the special case, i.e. identity [4.8] ($P_t^* = P_t$), and negative ($P_t^* < P_t$) in regime 2. The variable δP_t could then be used as a sample separation value,

i.e. to discriminate observations between those which belong to the demand schedule and those which correspond to the supply curve. Under the assumption of proportionality between excess demand and price changes $(P_t^* - P_t)$, equation [4.10] can also be expressed as:

$$[4.11] \qquad P_t - P_{t-1} = \phi(D_t - S_t) \qquad 0 < \phi < \infty$$

where ϕ is the speed of price response to excess demand and others as defined above.

This establishes behavioral relationships between price changes and excess demand and further more the proportionality assumption poses similar statistical property in these two variables. Equation [4.11] therefore suggests that agents' behavior with regard to excess demand can be captured by price changes thereby establishing the basis for using price changes as proxies for excess demand.

The inclusion of excess demand into the econometric model (a) introduces joint density function between P_t and Q_t, (b) avoids the truncation of the parameter space, (c) makes P_t and Q_t single-valued functions of each other, and (d) brings consumers' and producers' desires into the realm of consistency. Estimation of the respecified model with an econometric technique that allows for particular constraints such as cross-equation restriction posed on the parameters and non-linearity in the parameters introduced in the

respecification process yields consistent, asymptotically normal and efficient parameter values [5; 6].

4.2 The Validity of the Minimum Condition

The assumption that the short side of the market dominates, identity [4.7], is basic to disequilibrium models. It ensures the condition that at any time at least one of the market agents (consumers or suppliers) are on their ex ante function. Without this assumption, identification of ex ante relationships using ex post quantities is impossible. Some researchers however have questioned its validity. Among others, Richard [113] and Hendry and Spanos [57] substitute it with the minimum of the expected values of desired demand and supply quantities. This specification of the minimum condition was subsequently applied by Sneessens [118; 119]. Its justification as a behavioral equation is however questionable [85, p. 1660].

Muellbauer [99] and Muellbauer and Portes [100] argued against the application of the minimum condition to macro models. However, Batchelor [11] and Muellbauer and Winter [101] suggest that the danger of using the minimum condition in macro models can be abated by appropriate modifications in the light of the assumptions made about the aggregation procedure. Bouisson et al [21], for example, suggest survey data as an appropriate one for the analysis of disequilibrium

models at aggregate level. Maddala [83; 84] however shows that the specification of the minimum condition as given by expression [4.7] is appropriate for disequilibrium models.

4.3 The Disequilibrium Econometric Model

The desired demand [4.1] and supply [4.2] functions form the basis for the disequilibrium market model. The deviation from the usual equilibrium model begins with relaxing the market clearing identity, [4.3]. This means that, at least, one of the desired quantities (i.e. quantities demanded or quantities supplied), is not identical to transacted quantities. By virtue of [4.7], however, transacted quantities are bound to equal the minimum of the ex ante quantities (quantity demanded or supplied).

Albeit the price level can be traced by projecting transacted quantities to the price axis through the minimum of desired quantity schedules (Figure 4.1), the nature of agents' behavior is unknown. The non-clearing market behavior also implies that prices are not determined in the usual way, i.e. by conventional price movers. An econometric specification of a disequilibrium market model therefore requires that a price adjustment equation be an integral part of the system. Mayer [88], for example, argues that unlike in a competitive market, parameter estimates in a disequilibrium model are variant to the way prices adjust from one

observation to another.

As argued earlier (§4.1), a Walrasian price adjustment mechanism [4.11] is specified. The interpretation of equation [4.11] is that the market does not clear due to price stickiness. The complete disequilibrium market model therefore consists of the following three equations and one identity.

$$[4.1]' \quad D_t = \alpha_{m-2} + \alpha_{m-1}P_t + \Sigma\alpha_m X_{mt} + E_{1t}$$

$$[4.2]' \quad S_t = \beta_{j-2} + \beta_{j-1}P_t + \Sigma\beta_j Z_{jt} + E_{2t}$$

$$[4.11]' \quad \delta P_t = \phi(D_t - S_t) \qquad \text{(Price adjustment)}$$

$$[4.7]' \quad Q_t = \text{Min}(D_t , S_t) \qquad \text{(Minimum condition)}$$

The value of ϕ in the Walrasian price adjustment model ranges from zero to infinity (∞). When ϕ=0, price does not respond to excess demand, a case of complete disequilibrium. If ϕ attains its upper bound (∞), price is perfectly flexible and the market is in a steady state of equilibrium. Conditioned on the asymptotic normality of parameter estimates, the hypothesis $1/\phi = 0$ yields a statistical test for market equilibrium [38]. Based on a Monte Carlo experiment, Quandt [111] contend that the t-statistics for $1/\phi$ may not well be approximated by a normal distribution, implying that the test could be misleading.

In an effort to nest the equilibrium hypothesis and circumvent the statistical problem, depending on whether price

is endogenous or exogenous to the model, various versions of the Walrasian price adjustment model are suggested [18; 19; 38; 44; 65; 66; 75; 83; 85]. The choice among the alternatives depends on the cause of the market disequilibrium. When disequilibrium is invoked by sticky prices, Bowden's [18; 19] partial adjustment to an imputed moving equilibrium (PAMEQ) model is suggested to capture the agents' behavior in a non-clearing market. It is usually introduced as a discrete version of the Walrasian price adjustment model, [4.11].

$$[4.12] \quad P_t = \mu P_{t-1} + (1-\mu) P_t^* \qquad 0 < \mu < 1$$

Bowden [18; 19] has shown that equation [4.12] can be derived from equation [4.9]. This adjustment equation nests the equilibrium hypothesis ($\mu = 0$) and does not have statistical problem. Also μ is unit free lending itself for comparison across markets. Bowden assumes the existence of market clearing price, P_t^*, unobservable though, and defines the current price as a weighted average of P_t^* and previous year's price, P_{t-1}. The parameter μ is the coefficient of friction or measure of impediments. The coefficient of P_t^*, $1-\mu$, therefore measures the speed of adjustment in prices in response to changes in demand and/or supply determinants. Equation [4.12], by replacing the Walrasian price adjustment model [4.11], completes the disequilibrium market model

specification. From this disequilibrium econometric model, two sets of estimable equations can be derived each with different purposes, i.e. testing the equilibrium hypothesis and estimation of the structural parameters. First, the equilibrium hypothesis can be tested for mono and/or upward and downward differential adjustment speeds. The reduced form of the price equation can be used to test the mono adjustment speed hypothesis. Using equation [4.12], the reduced form of the endogenous variable (price) can be derived from equations [4.1] and [4.2]. Equating [4.1] with [4.2] and solving for P_t yields P_t^* in terms of all exogenous variables and error terms. Then substituing the resulting equation in [4.12] for P_t^* gives equation [4.13] (Appendix A2.1).

$$[4.13] \qquad P_t = \alpha_o^* + \mu^* P_{t-1} + {}_{\alpha i}{}^* X_i - \beta_j^* Z_j + v_t^*$$

where:
$$\alpha_o^* = (1-\mu)*(\alpha_o-\beta_o)/(\beta_1 - \alpha_1)$$
$$\mu^* = \mu$$
$$\beta_j^* = \{(1-\mu)/(\beta_1 - \alpha_1)\}\beta_j$$
$$\alpha_i^* = \{(1-\mu)/(\beta_1 - \alpha_1)\}\alpha_i$$
$$v_t^* = \{(1-\mu)/(\beta_1 - \alpha_1)\}*[E_{1t} - E_{2t}]$$

If the market is competitive, the demand and supply determinants (Xs and Zs) in equation [4.13] will determine prices and the parameter μ will not have statistical

significance. On the other hand, if the market operates under non-competitive behavior, prices will adjust slowly and μ will be statistically different from zero.

Differential upward and downward adjustment rates are also suggested [65; 66; 75; 83; 85]. The adjustment model, in this case, is:

$$[4.18] \quad P_t = \begin{cases} \mu_1 P_{t-1} + (1-\mu_1) P_t^* & \text{if } P_t > P_{t-1} \\ \mu_2 P_{t-1} + (1-\mu_2) P_t^* & \text{if } P_t < P_{t-1} \end{cases}$$

where $0 \leq \mu_1 , \mu_2 \leq 1$. These adjustment speeds are however to be estimated from the structural equations. Three hypothesis tests are possible from equation [4.18]. These are:

a) $\mu_1 = 0$ - to test for upward adjustment

b) $\mu_2 = 0$ - to test for downward adjustment

c) $\mu_1 = \mu_2$ - to test the equality of the upward and downward adjustment rates.

Second, the structural parameters are estimated from a system of equations consisting of the demand and supply functions corrected for the disequilibrium condition. Equating equation [4.1] with [4.2], we can solve for P_t^*.

$$[4.13]' \quad P_t^* = 1/\beta_1-\alpha_1 * [\beta_o-\alpha_o + \beta_j'Z-\alpha_i'X + E_{2t}-E_{1t}]$$

Then (a) using condition [4.7] for regime identification, (b) defining desired quantities as the sum of transacted quantities and excess demand, and (c) using the price

adjustment equations, [4.18], we obtain the correction factors, P_t^+ and P_t^- [Appendix A2.2]. The system of structural equations is then given as:

$$[4.15] \quad D_t = \alpha_{m-2} + \alpha_{m-1}P_t + \Sigma\alpha_m X_{mt} + \alpha_{m+1}P_t^+ + E_{1t}$$

$$[4.16] \quad S_t = \beta_{j-2} + \beta_{j-1}P_t + \Sigma\beta_j Z_{jt} + \beta_{j+1}P_t^- + E_{2t}$$

$$[4.7]' \quad Q_t = \min(D_t , S_t)$$

where

$$P_t^+ = \begin{cases} P_t - P_{t-1} & \text{if } P_t > P_{t-1} \\ 0 \quad \text{otherwise} \end{cases}$$

$$P_t^- = \begin{cases} (-1)*P_t - P_{t-1} & \text{if } P_t < P_{t-1} \\ 0 \quad \text{otherwise} \end{cases}$$

$$\beta_{m+1} = \{\mu_1 (\beta_1 - \alpha_1)\}/(1-\mu_1)$$

$$\beta_{j+1} = \{\mu_2 (\beta_1 - \alpha_1)\}/(1-\mu_2)$$

The price adjustment equation is integrated into the first two equations [4.15] and [4.16]. The respecified model therefore is "identical" to the system of structural equations given under equations { (4.1)', (4.2)', (4.7)' and (4.12)}. The market equilibrium hypothesis then becomes a nested hypothesis lending itself for a statistical test.

4.4 Methodology

With the introduction of P_t^+ and P_t^-, however, the respecified system of equations indicated in equations {[4.15], [4.16] and [4.7]'} is different in three ways from the original one. First, the newly introduced variables are not linear in the parameters albeit P_t is. Second, the simultaneous appearance of the price coefficients (β_1 and α_1) in the demand and supply equations poses a cross-equation restriction. Third, the error terms are correlated via equation [4.11] even if they are uncorrelated in the original functions. This does not however pose special estimation problem.

The structural parameters can be consistently estimated by linear instrumental variable or two-stage least square methods provided that the predetermined variables are well behaved. More efficient (with less variance) estimators could be obtained by the application of system estimator that permit non-linearity, cross-equation restriction and contemporaneous correlation across equations.

Both the non-linear three-stage least square (NL3SLS) and full information maximum likelihood (FIML) allow cross-equation restriction and non-linearity in the parameters. The NL3SLS is asymptotically less efficient than the FIML but has an advantage over the latter in that its asymptotic properties do not depend on the specification of the function [6]. In

other words, the desirable properties of the FIML estimators crucially depend on the validity of the normality assumption about the distribution of the error terms while the NL3SLS estimators can retain their desirable properties (consistency and asymptotic normality) even if the normality assumption is violated or more generally the model is not correctly specified [6]. In this study both the instrumental variable (IV)/two-stage least square (2SLS) and the nonlinear three-stage least square (NL3SLS) methods are used.

4.5 The Empirical Model

Theory of demand suggests that consumers move in a commodity space in search of a commodity bundle that maximizes their utility conditional on their budget. The budget constraint is determined by the consumer's income level and a vector of prices. An increase (decrease) in the income level given prices, would expand (contract) the budget constraint. An increase (decrease) in at least one of the prices at given level of nominal income and other prices would contract (expand) the budget constraint via the real income effect. Thus given the non-satiation axiom, consumers respond to any change in either income or price levels or non-proportional change in both by moving along each commodity vector until they reach a new optimal commodity bundle. Because the commodities are assumed to be normal, the moves are non-

negative. Note however that quantities demanded are invariant to proportionate changes in all prices and income, i.e. the demand functions are homogeneous of degree zero in all prices and income. From here we can conclude that the demand (D_t) for any commodity (beef in our case) depends primarily on income (I_t) and a vector of prices (**P**).

$$[4.17] \quad D_t = F(\mathbf{P}, I_t)$$

Entrepreneurs confronted with this demand , will respond to changes in supply determinants - retail price of beef (P_t) and cost of supply. It has been shown in chapter three that supply of beef in Japan has two components - domestic and imports (imported on hoof are not included). Japan's self-sufficiency ratio has been declining over time, [Table 3.2.] indicating an increasing import component of the supply of beef. Import price (I_{pt}) therefore should have influenced the supply function. The domestic component of the supply of beef can be affected by feed cost (F_{ct}) and cattle inventory on feed lots (C_t). These variables combine to determine the level of entrepreneurs' margin. Entrepreneurs are assumed to seek to maximize their profit and hence respond to a change in their profit margin. The supply function is therefore given as:

$$[4.18] \quad S_t = G(F_{ct}, I_{pt}, C_t, P_t)$$

Data generation processes (functional forms) are seldom known

to economic theory. It is suggested however that consumption functions are non-linear both in the variables and parameters [12]. Researchers however usually adopt linear and/or log-linear forms in estimating demand and supply functions. The log-linear permits non-linearity in the variables. It should be noted however that these specifications do not have particular relevance other than simplification.

There is no single best way to know functional forms. In this study, both linear and log-linear functions are used. However, because earlier reports we wish to compare our results with were not estimated in a system context or did not use, by the disequilibrium hypothesis, the appropriate estimation method, we limit the linear specification only to the equation by equation estimation methods, i.e. instrumental variable (IV) or two-stage least square method.

4.6 Variables and Data

Variables used in this analysis are listed in Table 4.1 along with their definitions and expected signs as implied by theory. All data are obtained from published sources. There exist fairly large number of data sources. Acquisition of representative (both commodity and market wise) data, however, is difficult, particularly in the case of the Japanese beef market.

Table 4.1

Variables, Definitions and Measurements

Variables	Expected signs D_t	Expected signs S_t	Definitions
D_t		na*	Desired demand for beef at time t
S_t		na	Intended supply of beef at time t
Q_t		na	Transacted quantity, i.e annual per capita consumption of beef in kg
P_t	(-)	(+)	Retail price of beef in ¥ /kg
P_{st}	(+)		Retail price of substitutes in ¥/kg
I_t	(+)		Per capita expenditure on beef in ¥(mil)
F_{ct}		(-)	Fattening cost in ¥/1000 head
I_{pt}		(-)	CIF (cost - insurance - freight) import price of beef in ¥/kg
C_t		(-)	Cattle inventory on feedlots (1000s)
P_{t+}	(-)		Price change in excess demand regime
P_{t-}		(+)	Price change in excess supply regime

* na = not applicable.

Previous researchers have directly or indirectly relied upon two quantity and price data sources, the Statistical Yearbook (SYB) and the Family Income and Expenditure Survey (FIES), both of the Ministry of Agriculture, Forestry and Fisheries (MAFF). In quest of completeness, two data sets are used in this study, i.e. one from each source. For reference purposes, the data set from SYB is referred to as Market I and that from FIES Market II. The Statistical Year Book contains (a) two beef price series, loin and medium grade, (b) two pork price series, loin and medium grade, and (c) single chicken price series. All prices are retail level in Ku area of Tokyo. The loin price series of both beef and pork

are not consistently reported and were not used in this study. Since the beef and pork prices are only of a single grade and the Tokyo market is metropolitan, the representability of these prices for the national market condition is questionable. Quantity data for Market I are taken from Hayes et al [54], Table 5.

Mori and Gorman [95; 96], however, argue that the Tokyo central market wholesale[21] beef prices represent well nation-wide market conditions. Their argument is based on two facts. First, they computed a correlation coefficient of 0.98 between Tokyo central market and average of all other central markets' monthly wholesale prices of holstein steer, 2nd grade. The corresponding correlation coefficient for wagyu steer, 2nd grade was 0.96. Second, the Tokyo central market wholesale carcass prices of beef are used by the Ministry of Agriculture, Forestry and Fisheries (MAFF) as indicators of nation-wide market conditions for the purpose of market information services and beef price stabilization program. In addition, most meat centers determine producer prices in reference to the Tokyo central market wholesale prices [96, p. 82].

A high correlation coefficient and officials' belief and subsequent use of the Tokyo central market wholesale prices in their market-related decisions may however be only an indicator for the existence of correlation between the captioned prices but not a sufficient condition for the

conclusion that the Tokyo central market wholesale beef prices represent nation-wide market conditions. The high correlation coefficient, for example, may be spurious [74; 112].

Officials' use of the Tokyo central market wholesale prices as their guide in the determination of prices at other centers certainly introduces association between the two sets of prices and also among prices of other centers via the Tokyo price. Such association, however, is imposed rather than causal. Its strength depends on the frequency of the shock (episodes) and relative strength of local market forces in each center. In general, it would be of a discrete nature as it does not arise from the dynamics of the markets implying incomplete mapping between events in the markets of concern. Longworth [82, p. 180], for example, has reported that the Tokyo and Osaka central markets, whose wholesale official prices are used by the MAFF in the determination of short-term import and price stabilization strategies, are far from perfection and also thin.

The second source of data, the Family Income and Expenditure Survey (FIES), covers a relatively larger area and employs sound survey technique (Appendix A3.2). Retail level prices and quantity are reported. Two limitations are on the FIES data - its exclusion of farm households and consumption away from home [82, p. 276]. These limitations may erode the representability of data particularly on beef because beef consumption in the outside home market segment is important.

Blagg [15], for example, has reported that beef has become increasingly important with the growing restaurants. Furthermore, beef is the first important meat in this market [40] and a large proportion of the increase in beef consumption occurs in this market [82, p. 276]. Nevertheless, the FIES has good temporal and commodity coverage [35].

Other data are sourced from different publications. Per capita private consumption expenditure is derived from private consumption expenditure, human population and annual average exchange rates obtained from the International Financial Statistics [64]. Cattle fattening and labor costs are obtained from Annual Statistical Yearbook. Beef import prices are proxied by the quotient of the values and corresponding quantities of beef imports [39] converted into Yen using International Monetary Fund (IMF) exchange rates. All monetary values in this study are deflated[22] by consumer price indices (1980=100) obtained from IMF [64].

CHAPTER 5

RESULTS OF THE ECONOMETRIC ANALYSIS

5.1 General

We test the equilibrium hypothesis using (a) mono-adjustment rate, and (b) different upward and downward adjustment rates. The uniform adjustment rate is estimated from the reduced form of the price equation, [equation 4.13]. It is hypothesized that if the market has had an overt competitive behavior, most of the variations in the dependent variable (beef price) would be due to

$$[4.13]'' \quad P_t = (1-\mu)(\alpha_o-\beta_o)/\beta_1-\alpha_1 + \mu P_{t-1} + [\{(1-\mu)/\beta_1-\alpha_1\}\alpha_i X_i - \{(1-\mu)/\beta_1-\alpha_1\}\beta_j Z_j] + \{(1-\mu)/\beta_1-\alpha_1\}[E_{1t} - E_{2t}]$$

the terms in brackets, i.e. demand and supply determinants. The coefficients to these variables are composite parameters and do not serve the purpose at hand. The parameter of interest here is the coefficient of the lagged price, μ. If the null hypothesis $\mu=0$ is not accepted, then the terms in brackets have no statistically measurable impact on the price adjustment process and the market is characterized by disequilibrium conditions. Failure to reject the null hypothesis, on the other hand, suggests a competitive market

behavior. Equation [4.13] was estimated using SHAZAM Version 6.0 on IBM/PC computer. Following the acceptance of the alternative (disequilibrium) hypothesis, the structural parameters and hence the upward and downward differential adjustment speeds are estimated. In this case, release 6 of Time Series Processor (TSP) is used on IBM Model 4381.

5.2 Discussion of the Results

5.2.1 Tests for the Equilibrium Hypothesis

Regression results from the reduced price equation (SP1) are presented in Table 5.1. The appearance of the lagged price variable on the right hand side of equation [4.13] invalidates the use of Durbin-Watson statistics as a test for the presence of first order autocorrelation [34]. To avoid indeterminancy problem in computing Durbin h statistics, the alternative statistics (m) is used.

The Durbin m statistics do not suggest the presence of serial correlation. Nevertheless depending on the assumption about the structure of the error terms, alternative estimation methods are used. When the error terms are assumed to be both serially and contemporaneously uncorrelated, the ordinary least squares (OLS) yields unbiased and consistent

The estimated equation is:

$$[4.13]'' \quad P_t = (1-\mu)(\alpha_o-\beta_o)/\beta_1-\alpha_1 + \mu P_{t-1} + \{(1-\mu)/\beta_1-\alpha_1\}\alpha_i X_i - \{(1-\mu)/\beta_1-\alpha_1\}\beta_j Z_j + \{(1-\mu)/\beta_1-\alpha_1\}[E_{1t} - E_{2t}]$$

Table 5.1

Estimated Price Adjustment (mono) Rates, Linear Model

Parameter	Market 1 OLS	Market 1 GLS	Market 1 IV	Market 2 OLS	Market 2 GLS	Market 2 IV
μ	0.5283	0.5592	0.4049	0.6665	0.6592	0.6238
	(1.813)	(1.903)	(1.253)	(2.930)	(3.181)	(2.123)
α_2	0.2951	0.2374	0.3975	-.0629	0.0802	-.0648
	(0.624)	(0.505)	(0.812)	(0.175)	(0.238)	(0.180)
α_3	1.2449	1.2908	1.1819	1.5248	1.1822	1.5738
	(0.944)	(1.048)	(0.897)	(1.854)	(1.447)	(1.850)
α_4	1.5271	1.5902	1.5782	0.6444	0.5356	0.7073
	(1.066)	(1.151)	(1.093)	(1.487)	(1.253)	(1.379)
α_5	0.00001	0.00001	0.00001	0.9E-5	0.9E-5	0.9E-5
	(1.680)	(1.553)	(1.625)	(2.258)	(2.372)	(2.171)
β_2	-.0006	-.0006	-.0004	-.0003	-.0002	-.0003
	(0.539)	(0.559)	(0.336)	(0.558)	(0.437)	(0.408)
β_3	0.2849	0.3449	0.2238	0.4535	0.5039	0.4351
	(0.930)	(1.105)	(0.709)	(2.798)	(3.418)	(2.402)
β_4	-.0111	-.0096	-.0108	-.0013	-0.0034	0.0010
	(1.526)	(1.262)	(1.472)	(0.257)	(0.683)	(0.185)
C	-18.6570	-18.3850	-13.4180	-22.0440	-15.1380	-22.862
r^2	0.683	0.697	0.678	0.873	0.879	0.873
r^2-adj	0.471	0.495	0.463	0.789	0.818	0.787
Dn. m*	0.434	.	.	0.492	.	.
	(0.96)	.	.	(1.26)	.	.

Source: Computed from data in Appendix 4.
* Dn. m = Durbin m statistics.
t-statistics in parentheses.

estimators. If the disturbance terms are serially correlated, we can employ either the generalized least squares (GLS) method if the autocorrelation structure is identical, or instrumental variable (IV) method if the structure is different. Lagged values of all pre-determined variables can be used as instruments for P_{t-1}. Both methods yield consistent estimators. For the OLS and GLS estimators, the usual t-statistics can be used to test the coefficient of friction (μ) for statistical significance.

Since partial adjustment rates are confined to fall within the interval (0 , 1), [equation 4.12] a one-tailed ($t > 0$) test is appropriate. For the first market (adj. $r^2 = .47$ and .50 for OLS and GLS respectively), the critical t-value at $\alpha = .05$ probability level with 12 degrees of freedom is 1.782. Both the OLS and GLS estimators, [Table 5.1], do not support the rejection of the alternative (disequilibrium) hypothesis, $\mu = 0$. The test is even stronger for market II. Adjusted r^2s for OLS and GLS estimators are 0.79 and 0.81 respectively, much higher than those for the first market. Furthermore, the t-test does not support the null hypothesis ($\mu=0$) at $\alpha = .01$ probability level (critical t-value at 12 degrees of freedom = 2.681). The IV estimators are consistent but cannot be tested for statistical significance with t-statistics due to unknown distribution. Under the linear model hypothesis, there exists a statistical indication that both markets have had some degree of disequilibria, as expected, during the

The estimated equations is:

$$[4.13]'' \quad P_t = (1-\mu)(\alpha_o-\beta_o)/\beta_1-\alpha_1 + \mu P_{t-1} + \{(1-\mu)/\beta_1-\alpha_1\}\alpha_i X_i - \{(1-\mu)/\beta_1-\alpha_1\}\beta_j Z_j + \{(1-\mu)/\beta_1-\alpha_1\}[E_{1t} - E_{2t}]$$

Table 5.2

Estimated Price Adjustment (mono) Rates, Log-Linear Model

Parameter	Market 1 OLS	Market 1 GLS	Market 1 IV	Market 2 OLS	Market 2 GLS	Market 2 IV
μ	0.4018	0.4006	0.1597	0.3787	0.3962	0.1870
	(1.464)	(1.440)	(0.454)	(1.276)	(1.309)	(0.345)
α_2	0.1930	0.1933	0.4475	-.2044	-0.1547	-.2153
	(0.718)	(0.713)	(1.087)	(0.808)	(0.613)	(0.829)
α_3	0.5445	0.5516	0.4996	0.8449	0.7611	1.0063
	(1.317)	(1.349)	(1.166)	(2.077)	(1.862)	(2.152)
α_4	-.0179	-.0030	0.0097	0.0040	0.0041	0.0789
	(0.069)	(0.011)	(0.036)	(0.023)	(0.023)	(0.382)
α_5	0.3379	0.4499	0.4473	0.1902	0.1947	0.1926
	(1.956)	(1.911)	(1.833)	(2.139)	(2.109)	(2.112)
β_2	-.1503	-.1502	-.0620	-.0727	-.0720	-.0071
	(0.749)	(0.748)	(0.281)	(0.547)	(0.538)	(0.044)
β_3	0.0129	0.0185	-.0013	0.0363	0.0428	0.0234
	(0.363)	(0.405)	(0.0335)	(1.363)	(1.589)	(0.729)
β_4	-.4496	-.3022	-.2728	0.2381	0.1682	0.3810
	(0.025)	(0.913)	(0.813)	(0.667)	(0.469)	(0.927)
C	-.5928	-.7493	-1.1187	-3.2583	-2.7738	-4.7003
r^2	0.709	0.711	0.690	0.848	0.853	0.840
r^2-adj	0.515	0.518	0.484	0.747	0.755	0.763
Dn. m	0.187	.	0.289	.	.	.
	(0.33)	.	(0.66)	.	.	.

Source: Computed from data in Appendix 4.
Dn. m = Durbin m statistics.
t-statistics in parentheses.

sample period. The test[23] for different degree of disequilibria between the two markets was however rejected at the 10% level of significance.

Estimates from the log-linear model are reported in Table 5.2 with t-values in parentheses. The standard errors are computed from the quadratic form of analytic first derivatives. Unlike for market II, the equilibrium hypothesis for market I cannot be accepted at $\alpha = .10$ (t-critical=1.356). This difference may be due to the functional form. When the log-linear model is adopted, the coefficient of determination (r^2) for market I increases while that for market II declines indicating probably that the data from market II is better explained by a linear model. Since both data sets suggest disequilibrium condition in the two markets, the specified disequilibrium econometric model [§4.3] is used to estimate the structural equations.

5.2.2 The Structural Parameters

The structural parameters are estimated from the double log model using (a) two-stage least square (2SLS), and (b) NL3SLS methods. Each of these is discussed below.

5.2.2.1 Single Equation (2SLS) Estimators

Hausman [50] has shown that the 2SLS (IV) estimators of linear and nonlinear models are consistent and uniformly asymptotically normal. Amemiya [5] extended this consistency

The system of equations estimated is:

$$[4.15]' \quad D_t = \alpha_{m-2} + \alpha_{m-1}P_t + \Sigma\alpha_m X_{mt} + \alpha_{m+1}P_t^+ + E_{1t}$$

$$[4.16]' \quad S_t = \beta_{j-2} + \beta_{j-1}P_t + \Sigma\beta_j Z_{jt} + \beta_{j+1}P_t^- + E_{2t}$$

$$[4.7]' \quad Q_t = \min(D_t , S_t)$$

Table 5.3

Single Equation (IV) Estimates of the Structural Parameters, Log-Linear

Parameter	Market I Coeff	t-stat	Market II Coeff	t-stat	Variable (in logs)
			Demand		
α_o	-10.121	-1.034	-1.293	-.709	Intercept
α_1	-3.187	-1.405	-2.400	-2.747	Beef
α_2	1.209	1.030	-.052	-.159	Pork
α_3	1.197	.763	1.065	1.893	Chicken
α_4	.770	1.212	.627	2.466	Fish
α_5	1.009	1.368	.552	2.817	Income
μ_1	.008	.	.025	.	P^+
			Supply		
β_o	-10.570	-2.923	-7.058	-.944	Intercept
β_1	.866	1.418	.187	.200	Beef
β_2	-.654	-1.591	.315	.386	Feed
β	-.066	-1.056	-.250	-.682	Import
β_4	1.873	10.103	.843	3.098	Inventory
μ_2	.039	.	-.276	.	P^-

Source: Computed from data in Appendix 4.

property to disequilibrium econometric models (equations 4.15 and 4.16). Results from this method are reported in Table 5.3 (n=21). All the estimated coefficients of the first market have the expected sign. In market II, only coefficients for pork price, feed cost and downward flexibility coefficient have wrong signs. The 2SLS estimates however are not asymptotically efficient due to the cross-equation restriction imposed on α_1 and β_1 and the nonlinearity of P_t^+ and P_t^- in the parameters [5].

5.2.2.2 System Estimators

It has been argued that both the NL3SLS and FIML methods allow nonlinearity and cross-equation restrictions. The latter however, though asymptotically more efficient [6; 14; 50], is restrictive as it requires exact specification of the model and strict normality in the disturbance terms. Jorgenson and Laffont [70] argue that minimum distance estimators can be used in estimating nonlinear systems with constraints across equations. These estimators are also shown to be consistent and asymptotically normal [4]. We therefore applied the NL3SLS method. Following Amemiya's [6] suggestion, the 2SLS estimates are used as starting values and the NL3SLS estimation is based on Jorgenson and Laffont's [70] minimum distance algorithm. The results are reported in Table

5.4 (n=21). With regard to Market I, all coefficients but μ_1 (which is not statistically significant) have the expected sign. The log-log model permits direct interpretation of coefficients as elasticities. The own-price (-2.934) and expenditure (0.855) elasticities are significantly different from zero at $\alpha = .10$ level. Pork and poultry prices do not

(Equations are same with those of Table 5.3)

Table 5.4

The NL3SLS Estimates of the Structural Parameters, Log-Linear

Parameter	Market I Coeff	t-stat	Market II Coeff	t-stat	Variable (in logs)
		Demand			
α_o	-9.087	-1.423	-1.552	-1.090	Intercept
α_1	-2.934	-1.982	-2.337	-2.805	Beef
α_2	.854	1.087	-.183	-.439	Pork
α_3	1.269	1.276	1.144	2.711	Chicken
α_4	1.213	3.223	.637	3.037	Fish
α_5	.855	1.818	.559	3.443	Income
μ_1	-.009	-.510	.029	2.134	P^+
		Supply			
β_o	- 9.741	-3.187	-5.192	-1.903	Intercept
β_1	.993	1.878	.107	.272	Beef
β_2	-.837	-2.555	.113	.359	Feed
β_3	-.087	-1.710	-.099	-.804	Import
β_4	1.920	12.171	.818	7.177	Inventory
μ_2	.037	.995	-.090	-.618	P^-

Source: Computed from data in Appendix 4.

have statistically measurable influence on beef consumption. Fish seems to be the only strong substitute for beef in this market with cross-price elasticity of 1.21 (significant at 1% level).

Feed cost and cattle inventory on feedlots are major supply determinants (statistically significant at 5 and 1% level respectively). A 10% rise in feed cost reduces beef supply by 8.4%. There is also a statistical indication that producers respond to changes in beef retail prices. Import prices have the expected sign but the statistical significance holds only at 20% probability level.

With regard to Market II, all coefficients but pork price in the demand function have the expected sign. The own-price and income elasticities are statistically significant at 2% and 1% level respectively. Beef demand responds to changes in poultry and fish prices. Only cattle inventory affect the supply of beef to this market. While the downward flexibility coefficient has neither the expected sign nor statistical significance, the upward flexibility coefficient in the demand function shows rigidity with statistical significance at the 5% level.

Comparing Market I with Market II, one can observe that the demand factors exhibit certain degree of influence in both markets. Elasticities in Market II are less in magnitude[24] and also have less variability, probably due to possible spread of disturbances over a larger geographical area. In addition,

if the extent of integration between Market I and other central markets is weak, "shocks" from economic changes in Tokyo and Osaka markets will seldom influence prices in other markets.

Analogously magnitude and variability differences between supply coefficients in the two markets are apparent. Most supply factors in Market I have statistical significance, at least at 10% level. Market forces other than cattle inventory, hardly influence beef supply to market II. This may suggest that most beef supply comes from livestock dealers/wholesalers whose reservation prices are determined by a different information set. Also in markets with no overt competitive behavior, agents are likely to differ in their beliefs, valuation, and amount of information they possess [115] leading to a greater dependence of agents' behavior on non-market information. Salop [114] shows how price dispersion across agents allows one to exercise discriminatory pricing. The weak influence of import prices may be explained in terms of (a) most of imported beef is consumed away from home which is not included in the consumption data for market II, and (b) beef supply does not immediately respond to changes in import prices due to LIPC's mediation through storing and placing imported beef in the market.

Both upward and downward adjustment speeds in Market I do not have statistical significance. This implies perfect

flexibility in prices on annual basis. The model, however, does not say anything about the behavior of the market over a period less than a year. In the presence of annual formula pricing that has been in place for most of the sample period, the compliance of prices to flexibility rule should not be surprising. Instead, the results should be interpreted cautiously.

The downward adjustment speed is flexible also in Market II, implying absence of excess supply. Upward adjustment, however, has been rigid (μ_1 significant at about 5% level) indicating that the sample period was characterized by excess demand. These observations are consistent to expectation. Higher beef retail prices than competitive level (as measured by world price) [10; 37; 82; 93; 96; 97; 98] imply shortage of supply. Furthermore, government intervention in the form of supply management has confined price and quantity movements between periods to only the demand curve [102]. About 90% of the observations in the sample were identified with the demand schedule.

5.2.2.3 Comparisons with Others' Estimates

Not only the approach but also the data set and the time frame used in this and other studies differ from each other. Results therefore are not directly statistically comparable.

Nevertheless their juxtaposition may shed additional light on array of alternatives policy makers face. This summary therefore is an aide to information users but in no way statistical comparison. Previous demand studies have reportedly found that total beef consumption is both income and price elastic [82, p.277]. Teal et al [122] estimated the demand function for total beef using two different functional forms, quantity dependent and almost ideal demand system. In the first case, beef price and income elasticities are greater than unity. When the AIDS model is used, however, beef consumption is price inelastic (Model 9 in Appendix 1). Our parameter estimates, on the other hand, reveal that beef consumption is income inelastic in both markets. It is however more price responsive than envisaged by previous studies. Other differences relate to the issue of substitutability among alternative sources of animal protein. Although traditionally the Japanese heavily depend on fish for their animal protein, previous researchers have reported that beef and fish do not substitute each other [55] while pork competes with beef more than even poultry (Appendix 1). The disequilibrium specification, on the other hand, suggests that beef has to compete not with pork but with fish for the limited consumer budget.

CHAPTER 6

SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

6.1 Summary and Conclusions

Beef consumption in Japan has substantially outpaced domestic production. Consequently, imported beef constitute a large part of total beef supply. It is reported that consumers distinguish between domestic and imported beef and between different quality categories within each. While the bases of differentiation for imported component have been country of origin and product form (e.g. grain-fed vs grass-fed), emphasis, in categorizing domestic beef, has been placed on degree of marbling. Domestic beef is grouped into six categories. The most commonly used in descending order are supreme, superior, excellent, medium, common and utility.

Domestic beef is produced from native/beef breed (wagyu) and holstein cattle. Wagyu is the traditional supplier of beef. It is also highly marbled (fed over a longer period) and "superior"
to holstein beef. There has been, however, a shift in the composition of beef output towards holstein beef. Available data revealed that between 1971 and 1984, holstein beef increased from 45% to 64% of total domestic production.[25] By 1987, holstein accounted for 68% of total domestic beef production [89]. Within each breed, beef and holstein, beef

production from steers increases at the expense of that from females. The proportion of graded beef in total domestic beef output also has increased over time, from 23% in 1971 to 45% in 1981. The contribution of wagyu and holstein cattle to graded beef trends analogous to that of output. This time however, increased graded holstein beef originates only from steers.

Contrary to the common opinion, wagyu beef is spread over the six quality categories. In fact, the proportion of wagyu that attains the two top quality categories is minimal, less than 5%. Available data[26] suggest that about 50% of graded wagyu falls under the medium (2^{nd} grade) category. The proportion of wagyu beef graded as excellent (1^{st} grade) decreases through time while that of common (3^{rd} grade) shows an upward trend. Similarly, the majority of holstein beef is graded as common (3^{rd} grade). It seems however that almost all of the incremental graded holstein beef goes to the medium (2^{nd}) grade. A constant share (a little more than 10% of total graded beef) of holstein beef is categorized as utility. Some researchers attempted to match imported (mainly from U.S. and Australia) beef with the different quality categories of domestic beef. Some base their classification on public opinion (e.g. of policy makers, traders or restaurants) others rely on price differentials. Pursuing the latter approach, we found that the U.S. beef[27] is (a) superior to that imported from Australian, (b) below the medium grade of wagyu, and (c)

below the excellent grade of holstein beef.

Based on the policy intervention, increased concentration in the production and distribution sectors, heterogeneity of beef, and short-run supply rigidity, it was argued that the Japanese beef market may better be explained by disequilibrium rather than the conventional equilibrium market model. Partial price adjustment due to lag in information flow was advanced as the primal cause for market disequilibria. Accordingly, a disequilibrium econometric model was specified from which the market was tested for the equilibrium hypothesis and the structural parameters were estimated.

Uniform price adjustment speeds were estimated from the reduced form of the price equation. Estimates from the linear model suggest that prices in Market I have been adjusting from 44% to 60% on annual basis. Over the same period, adjustment speeds in Market II range from 33% to 38%. When the log-linear model is used, prices in both markets adjust from 38% to 84%.

However, the hypothesis of different upward and downward adjustment speeds is not supported by the annual data from Market I. This is not however surprising since the government have been fixing prices in this market using formula pricing on annual basis. Prices in Market II are not formula determined but are believed to be determined in reference to prices in Market I (Tokyo and Osaka central markets). Estimates from this data set suggest that upward adjustment

speeds have been rigid. This indicates that the market has been characterized by excess demand. Data set II does not include beef consumption away from home where most of the imported beef is consumed. In the face of sluggish domestic production and growing demand, the prevalence of excess demand is realistic.

Structural parameters are also estimated from the disequilibrium econometrics model using non-linear three stage least squares. Unlike in previous studies, beef consumption is found to be income inelastic (income elasticity = .86 and .56 in Market I and Market II respectively). The corresponding demand price elasticities are -2.93 and -2.34. These values are by far greater, in absolute terms, than previous estimates. Contrary to previous suggestions, beef has to compete not with pork but with fish and poultry for limited consumer budget.

An attempt was made to estimate the responsiveness of total beef supply in Japan to changes in average import prices. Because of LIPC's mediation between the world and the domestic beef markets (Market I), the coefficient was not statistically significant ($t = -1.71$) at reasonable probability level. The supply response to changes in beef and feed prices and also in cattle inventory on feedlots is statistically significant. None of the supply factors but cattle inventory in Market II has influenced beef supply.

6.2 Limitations

Price differentials may indicate market segmentation but do not necessarily suggest interdependence between those markets. The use of relative prices to delineate the intensity of product differentiation, however, presupposes interdependence between the different market segments, i.e. substitutability in consumption between products. If products are not substitutable, prices are determined independent of each other and price ratios change over time. This means that a given product would be categorized, before and after the price change, as different quality product at a given quality state. Since product substitutabilities in the Japanese beef market are not yet well known, the degree of product differentiation and estimated substitution elasticities need to be interpreted cautiously.

Due to absence of data by quality category, this study had to rely on (a) retail prices of only medium grade (Market I), and (b) aggregate price and quantity data (Market II). The reliability of parameter estimates from Market I data depends on how well other quality categories are related (in terms of substitutability) to the medium grade beef. The medium grade beef prices better represent prices of other products if prices change such that price ratios remain constant. If substitutability between medium grade and other products is nil, the parameter estimates would be biased.

Assuming that price averaging in Market II does not introduce aggregation bias, parameter values estimated from the aggregate data should be less than (in absolute terms) those underlying individual market segments. The use of annual data should have also camouflaged the price adjustment behavior.

Price fixing by the Ministry of Agriculture, Forestry and Fisheries has been augmenting economic changes into the annual price determination process. Supply parameter estimates in Market I may not, therefore, necessarily reflect producer or entrepreneur behavior.

6.3 Policy Implications and Suggestions for Further Research

With the publication of Longworth [82], beef in Japan begun to be perceived as highly differentiated product. Since then various authors have shown that domestic beef alone has six quality categories. Prices of imported beef also differ by country of origin and product form, e.g. grain-fed, grass-fed, frozen, chilled, aged. Differentiated products convey different but not necessarily unique preference structure. This means that each product exported to Japan certainly (a) qualifies largely for certain section of the market, and (b) competes with different products. The assessment of possible

effects of the intended beef trade liberalization therefore requires identification of, at least, major market segments and computation of the relevant cross-price elasticities.

The composition and time-trend of the different quality categories of domestic beef in Japan was investigated based on price differentials. Assuming that the price premia reflect real quality differences, i.e. consumers' preferences, the data suggest that the dynamics of the Japanese beef market centers on the two middle grades, medium and common. These are also known as 2nd and 3rd grades. Future demand studies, therefore, may benefit from concentrating on medium and common grades. Despite the substantial rise in beef consumption, the share of utility grade has remained at just over 10%. In addition, previous researchers have indicated that most of the imported beef has to compete with the utility grade of domestic beef. Future demand studies may therefore need to keep this grade in the picture.

Narrowing product differentiation may not necessarily reflect parallel trends in consumers' preference structure. In fact, the cost induced national campaign by the MAFF and increasing feed and labor cost may explain most of the structural shift within the beef sector. Trends in output by animal origin have suggested that due to resource (e.g. land, feed) constraints, poultry and pork have been "preferred" to cattle. If this holds, it may be plausible to assume that the same analogy may have played discriminatory role within

the cattle industry.

If the observed structural shift within the cattle industry is independent of consumers' preference, then unmet demand which may be exploited with little or no potential competition exists. Earlier recommendations [53; 80; 93] to feed U.S. steers for a longer period, to make them competitive with the vanishing wagyu may be used to serve these markets. Thus research may be geared to exploring (a) the causes of the structural shift within the cattle industry and (b) the peculiar characteristics of the clientele in the "open" markets.

As discussed earlier, the increase in the U.S. export of beef to Japan after trade liberalization is contingent on (a) the net price decline in Japan due to the liberalization, (b) the price elasticity of demand for the U.S. beef, (c) availability of alternative sources of animal protein, (d) quantity and competitiveness of beef from other sources, and (e) the supply capacity of the U.S. beef industry. While the high demand price elasticities in both markets signify promising liberalization effects, the cross-price elasticities, particularly beef-fish, are high enough to concern policy makers. Our estimates indicate that a 10% decline in beef retail prices will decrease the demand for fish by, at least, 6.4%. On the other hand, the 1987 the U.S. fish exports to Japan stood at 73% of total edible fish output, 67% in volume terms [125]. Japanese consumers also

tend to consume less poultry in response to downward trending in beef retail prices suggesting an increased beef export to Japan due to the liberalization may mean, for the U.S., redistribution of welfare within domestic sectors.

E N D N O T E S

[1] Econometric method contingent on the validity of assumptions underlying the model. One important assumption of an econometric model, for example, is stochasticity or randomness in the data. Randomness attributes all variations in the dependent variable to chance, i.e. non-systematic influences. This implies both temporal and cross-sectional state-independence. Such conditions can be violated by, for example, omition of relevant variables.

[2] The Australian government accuses Japan of the skewed quota administration in favor of the United States. The government of Japan, however, has described the quota allocation pattern as a reflection of consumers' preference.

[3] Prices in this study are defined to be efficient if they are unbiased, and have minimum variance [23]. Defining the forecast error as:

$$a) \quad e_{t+k} = P_{t+k} - P_t$$

and writing the following relationship in terms of the forecast error,

$$b) \quad E(e_{t+k} | e_t) = E(e_{t+k}) = 0$$

(where P_{t+k} is the k-period-ahead forecast price, and E is the expectation operator), prices are:

- unbiased iff the first equality in (b) holds, and
- serially independent iff the second equality in (b) holds.

Note however that this does not imply white noise property of the expectation model,i.e. the entire probability distribution of e_{t+k} may not be serially independent. For prices to follow also a random walk model, we assume that the information set ϕ_t on which expected prices are conditioned includes all price-relevant information implying information and model noise are uncorrelated [48].

[4] The specification with weighted average of high and low quality beef prices yields a substantially lower income elasticity than the one reported in the Appendix.

5 All growth rates in this study are computed using the formula:

$$r = \{[1/t(\ln Y_t - \ln Y_o)] - 1\} * 100$$

derived from $Y_t = Y_o (1 + r)^t$
where Y_t is the current value of the variable; Y_o is the value of the variable at the base year; r is the annual compound growth rate and t is the length of the period.

6 Stocks of imported beef are said to be sizeable [87]. Given the short shelf-life of beef however, it may be plausible to assume that beef purchased and stocked in period t cannot be stocked beyond period t+1. It is therefore assumed that year-end stocks can reasonably balance beginning inventories. Then all imports can be assumed to be consumed in the same year.

7 The volume, value and interaction effects on increased imports are computed as:

$$V_e = P_{o*}(Q_1 - Q_o) \;/\; P_{1*}Q_1 - P_{o*}Q_o$$

$$P_e = Q_o*(P_1 - P_o) \;/\; P_1*Q_1 - P_o*Q_o$$

$$I_e = (P_1 - P_o)*(Q_1 - Q_o) \;/\; P_{1*}Q_1 - P_{o*}Q_o$$

where V_e is volume/quantity effect; P_e is value/price effect and I_e is the interactive effect; Q_o and Q_1 are quantities traded during the base and terminal period respectively and P_o and P_1 are corresponding import values.

8 Wholesale meat centers were established to serve as media between livestock producers and consumers to facilitate information flow by eliminating middle men. Under this arrangement, producers can deliver their cattle directly to the centers and have the carcasses auctioned. Since 1958, ten centers and 16 sub-centers are established.

9 Grading standards are also changed in 1987. Mori et al [98] have indicated that changes in standards are still nil.

10 The shift in beef output composition from wagyu to holstein cattle may be a result of a shift in preference structure or a respond to changing cost structure. There exists also a shift from females to steers within wagyu and holstein.Here, possible causes may, in addition to the preference and/or cost issues, include such factors as retaining females for reproductive purposes, release of steers from alternative uses, e.g. draft power [37].

[11] Usually, wagyu beef is understood to be superior to holstein beef.

[12] Such factors however hardly vary with time and may be difficult, if not impossible, to justify their explanatory role. If they affect the demand for a product of a given source, they should shift the intercept but not the slope. As Johnson, Grennes and Thursby [69] put it, such effects could be incorporated into the historical market share.

[13] Quality-adjusted prices (intercepts) of, say, two products may not and need not be of equal magnitude. The estimated econometric model is not a demand model. Differences in quality-adjusted prices therefore can be attributed to differences in the omitted demand and supply forces in the respective markets.

[14] Intensity of product differentiation, $M = \Sigma e_{ij}/(n^2 - n)$ where e_{ij} is the cross-price elasticity between products i and j and n is the number of commodities in the market. The average cross-elasticity goes to ∞ as differentiation increases.

[15] This assumes that relative prices at different market levels are the same.

[16] Hayes [52] for example assumes a 50% decline in the price of holstein beef due to the liberalization, 35% above that of wagyu. This differential rate of decline is also observed by Mori and Gorman [93; 96].

[17] When the exchange rate effect is captured by price.

[18] Negative imports signify exports and zero balanced trade in beef.

[19] The optimal world price is determined by the interaction of excess demand and excess supply in the world market.

[20] When prices increase due to the new export demand, (a) firm profitability rises attracting idle or resources from other sectors, and (b) consumers shift to alternatives. Both will have positive effect on additional exports.

[21] Their argument for wholesale prices implicitly assumes that same argument holds for retail prices.

[22] It has been traditional to deflate monetary values in linear demand functions by general (consumer) price indices. The intent of using a numeraire is motivated by

the need to capture the effect of prices of commodities not included in the model [41]. Recent developments, however, have shown that deflation by general price index is justifiable only when the demand functions are homogeneous of degree zero in prices and income [33; 124, pp.440-21]. Coyle's [29] exposition of the effect of general price deflator on the property of linear demand functions supports arguments against using general numeraire since homogeneity in the real world rarely characterizes linear demand functions. The traditional consumer theory however requires that demand functions be invariant to equiproportional changes in prices and income.

[23] The standard error for the difference between the two adjustment speeds is computed as the square root of:

$$\mathrm{Var}(\mu_1 - \mu_2) = \mathrm{Var}(\mu_1) + \mathrm{Var}(\mu_2) - \mathrm{Cov}(\mu_1, \mu_2)$$

[24] The dependent variable for Market II is aggregate beef consumption per household (kg). This tends to lower the elasticities for log-log models.

Exposition: Let q_i be per capita consumption of beef (kg). Assuming a constant number of family members (with out loss of generality) over the sample period, and letting this number be "ϵ", the per household consumption, Q_i, is given as:

$$\text{i)} \quad Q_i = \epsilon q_i \qquad (\epsilon > 1)$$

Then, the consumption functions is:

$$\text{ii)} \quad q_i = \alpha + \beta M + e \qquad \text{(per capita)}$$
$$\text{iii)} \quad Q_i = \alpha_o + \beta M + v \qquad \text{(per household)}$$

where M represents any explanatory variable. The centroid elasticity of this consumption function with respect to M is given as a product of the coefficient (β) and the ratio of the explanatory to the dependent variable, (M/Q_i), i.e.

$$\text{iv)} \quad \text{Elasticity (E)} = \partial(Q_i)/\partial M \;.\; M/Q$$

Therefore,

$$E_1 = \beta \;.\; M/q$$

and

$$E_2 = \beta \;.\; M/Q$$
$$= \beta \;.\; M/\epsilon q \quad \text{(substituting from i)}$$

Where E_1 and E_2 are elasticities from (ii) and (iii) respectively. Thus E_2 is $< E_1$ since ϵ is > 1.

The variability is however invariant to the specification of the dependent variable. Scaling by a scalar of the dependent variable shifts the intercept and leaves the slope and hence the variability unaffected.

[25] Over the same period, total domestic beef output increased from 290 to 530 thousand metric tons.

[26] Data is available only upto 1981.

[27] Aggregated over product forms.

R E F E R E N C E S

1 Agricultural Policy Research Committee (APRC),Inc., (s.d). Beef Situation in Japan: From Production to Consumption. Tokyo.

2 Alston, Julian M., Colin A. Carter and Lovell S. Jarvis, 1989. Discriminatory Trade: The Case of Japanese Beef and Wheat Imports. Unpublished, Department of Agricultural and Resource Economics, University of California, Davis.

3 ----------, 1989. "Japanese Beef Trade Liberalization: It May Not Benefit Americans". Choices: The Magazine of Food, Farm and Resource Issues, 4(4) :26 - 31.

4 Amemiya, Takeshi, 1974. "The Nonlinear 2SLS Estimator." Journal of Econometrics, 2. :105-10.

5 ----------, 1974. "A Note on a Fair and Jaffee Model." Econometrica. 42(4) :759-62.

6 ----------, 1974. "The Maximum Likelihood and the Nonliynear Three-Stage Least Squares Estimator in the General Nonlinear Simultaneous Equation Model." Econometrica. 45(4) :955-68.

7 Aradhyula, Satheesh V. and Mathew T. Holt, 1989. "Risk Behavior and Rational Expectations in the U.S.Broiler Market." American Journal of Agricultural Economics, 71(4) :892-902.

8 Ardeni, Pier Giorgio, 1989. "Does the Law of One Price Really Hold for Commodity Prices." American Journal of Agricultural Economics, 71(3) :661-69.

9 Armington, Paul S., 1969. "A Theory of Demand for Products Distinguished by Place of Production." International Monetary Fund (IMF). Staff Papers, 16(1) :159-78.

10 Balassa, Bela, 1986. "Japan's Trade Policies." Weltwirtschaffliches Archiv, 122(4) :745-90.

11 Batchelor, R. A., 1977. "A Variable Parameter Model of Exporting Behavior." Review of Economic Studies, 44(1) :43-58.

12 Beef, 1987. "Sizing Up the Cattle Industry Future." Beef, 24(1) :82-6.

13 Benassy, Jean-Pascal, 1982. The Economics of Market Disequilibrium. Academic Press, London.

14 Berndt, E. K., B. H. Hall, R. E. Hall and J. A. Hausman, 1974. "Estimation and Inference in Nonlinear Structural Models." Annals of Economic and Social measurement, 3(4):653-65.

15 Blagg, Larry, 1987. "Solving the Japanese Food Service Industry Puzzle." Foreign Agriculture. July. Quoted in [72].

16 Bobst, Barry W., 1986. "Implications for Food Demand of Changes in Competitive State Within Marketing Channels." In: Capps, Oral, Jr. and Benjamin Senauer (eds.). Food Demand Analysis: Implications for Future Consumption. Department of Agricultural Economics, Virginia Polytechnic Institute and State University, Blacksburg. pp. 269-280.

17 Bohm, Volker, 1989. Disequilibrium and Macroeconomics. Basil Blackwell Ltd., New York.

18 Bowden, Roger J., 1978. "Specification, Estimation and Inference for Models of Markets in Disequilibrium." International Economic Review, 19(3) :711-26.

19 ----------, 1978. The Econometrics of Diseequilibrium. North Holland Publishing Co., Amsterdam.

20 Brandt, Jon A., Robert E. Young II, Shamsul Alam and Abner W. Womack, 1989. "Foreign Trade and Its Impacts on the Domestic Livestock Market." In: Rueben C. Buse (ed.), The Economics of Meat Demand, Proceeding of the Conference on the Economics of Meat Demand. October 20-21, 1986, Charleston, South Carolina: 307-27.

21 Bouisson, M. B., J. J. Laffont and Q. H. Vuong, 1983. "Disequilibrium Econometrics on Micro Data." Paper Presented at the European Meeting of the Econometric Society, Pisa, Italy. Quoted in [85]. Note: the year may be 1982. Maddala used 1982 in the text and 1983 in the reference.

22 Branson, Williams, 1972. "The Trade Effects of the 1971 Currency Realignments." Brookings Papers on Economic Activity, 1. :15-67.

23 Buccola, Steve, 1984. "Pricing Efficiency and Information Use in Risky Markets." American Journal of Agricultural Economics, 66(5) :711-6.

24 Chambers, Robert G., Richard E. Just, L. Joe Moffitt and Andrew Schmitz, 1982. "An Empirical Investigation of Disequilibrium in the U.S. Beef Import Market." In: Gordon C. Rausser (ed.). New Directions in Econometric Modeling and Forecasting in U.S. Agriculture. New York. Elsevier Science Publishing Co. pp. 389-404.

25 Chambers, Robert G., 1987. Applied Production Analysis: A dual Approach. Cambridge Univ Press, New York.

26 Chavas, Jean-Paul, 1983. "Structural Change in the Demand for Meat." American Journal of Agricultural Economics, 65(1) :187- 53.

27 Chavas, Jean-Paul, 1989. "On the Structure of Demand for Meat." In: Rueben C. Buse (ed.). The Economics of Meat Demand. Proceeding of the Conference on the Economics of Meat Demand. October 20-21, 1986, Charleston, South Carolina, :125-35.

28 Clower, Robert W., 1960. "Keynes and the Classics: A Dynamic Perspective." Quarterly Journal of Economics, 74(3) :318-23.

29 Coyle, Barry T., 1989. "A Comment on the Specification of Linear Equations for Consumer Demand, Output Supply and Factor Demand." Canadian Journal of Agricultural Economics, 37(2) :263-8.

30 Coyle, William T. and John H. Dyck, 1989. "Japanese Beef Trade Liberalization: It Will Benefit American Agriculture." Choice: The Magazine of Food, Farm and Resource Issues, 4(4) :26-31.

31 Deaton, Angus and John Muellbauer, 1980. "An Almost Ideal Demand System." American Economic Review, 70(3) :312-26.

32 Deaton, Angus and John Muellbauer, 1980. Economics and Consumer Behavior. Cambridge University Press, New York.

33 Diewert, W.E., 1976. "Exact and Superlative Index Numbers." Journal of Econometrics, 4 :115-45.

34 Durbin, J., 1970. "Testing for Serial Correlation in Least Squares Regression When Some of the Regressors are Lagged Dependent Variables." Econometrica, 38(3) :410-421.

35 Dyck, John H., 1987. Demand for Meats in Japan: A Review and an Update of Elasticity Estimates. USDA, Washington.

36 Eales, James S. and Laurian J. Unnevehr, 1987. "Demand for Beef and Chicken Products: Separability and Structural Change". American Journal of Agricultural Economics, 70(3) :521-44.

37 Egaitsu, Fumio, 1987. Japanese Agriculture and Cattle. Japanese International Agricultural Council. Tokyo.

38 Fair, Ray C. and Dwight M. Jaffee, 1972. "Methods of Estimation for Markets in Disequilibrium." Econometrica, 40(3) :497-518.

39 Food and Agricultrue Organization (FAO). Annual trade yearbook (various years), Rome.

40 Food Demand and Supply Research Center (FDSRC), 1984. Seasonal Meat Consumption Trend Report, Survey 10, Tokyo. Quoted in [72].

41 Freebairn, J. W. and Gordon C. Rausser, 1975. "Effects of Changes in the Level of U.S. Beef Imports." American Journal of Agricultural Economics, 57( ) :676-87.

42 Gorman, William D. and Hiroshi Mori, 1987. "Relative Prices of Imported Grain-Fed Beef in Japan: The Case of Air-Freighted Chilled Carcass." Agribusiness: An International Journal, 4(6) :535-48.

43 Gould, J. R. and S. G. B. Henry, 1967. "The Effects of Price Control on a Related Market." Economica, 34(133):42-9.

44 Green, Jerry and Jean-Jacques Laffont, 1981. "Disequilibrium Dynamics with Inventories and Anticipatory Price Setting." European Economic Review, 16(1) :199-223.

45 Grossman, Herschel I., 1974. "The Nature of Quantities in Market Disequilibrium." American Economic Review, 64(3) :509-518.

46 ----------, 1971. "Money, Interest, and Prices in Market Disequilibrium." Journal of Political Economy. 79(5) :943-61.

47 Grossman, Sanford J. and Joseph E. Stiglitz, 1976. "Information and Competitive Price Systems." American Economic Review, 66(2) :246-53.

48 ----------, 1980. "On the Impossibility of Informationally Efficient Markets." American Economic Review, 70(3) :393-408.

49 Harris, D., G. Corra and I. Shaw, 1989. Policy Changes Affecting Pacific Trade: A Preliminary Analysis. Paper Presented to Workshop on Agricultural Policy, Trade and Development. PECC/KREI. Quoted in [2].

50 Hausman, Jerry A., 1975. "An Instrumental Variable Approach to Full Information Estimators for Linear and Certain Nonlinear Econometric Models." Econometrica, 43(4) :727-38.

51 Hayami, Yujiro, 1979. "Trade Benefits to All: A Design of the Beef Import Liberalization in Japan". American Journal of Agricultural Economics, 61(2) :342-7.

52 Hayes, Dermot. J., 1989. "Beefing Up for the Japanese Market." Trade Issues and Opportunities. Midwest Agricultural Trade Research and Information Center, Paper No. 1. June, 1989.

53 Hayes, Dermot J., 1990. The Economics of Feeding, Processing, and Marketing Beef Animals for Export to the Pacific Rim. Invited Paper for Presentation at the 1990 AAEA Annual Meeting, University of British Colombia, Canada. August 3-8.

54 Hayes, Dermot J., John Green and Thomas I. Wahl, 1989. Marketing Meat in Japan: Economic Considerations. In: Marketing Meat in Japan: Preliminary Draft. The Second in the Series of Marketing Manuals. Midwest Agricultural Trade Research and Information Center (MATRIC), Ames.

55 Hayes, Dermot J., Thomas I. Wahl, and Gary W. Williams, 1990. "Testing Restrictions on a Model of Japanese Meat Demand." American Journal of Agricultural Economics, 72(3) :556-66.

56 Henderson, James M. and Richard E. Quandt, 1971. Microeconomic Theory: A Mathematical Approach. 2nd edition. McGraw-Hill Book Co., New York.

57 Hendry, D. F. and A. Spanos , 1980. "Disequilibrium and Latent Variables." Manuscript. London School of Economics. Quoted in [85].

58 Hicks, John R., 1965. Capital and Growth. Oxford University Press, Oxford.

59 Hicks, John R., 1978. Value and Capital: An Inquiry into Some Fundamental Principles of Economic Theory. Oxford University Press, Oxford.

60 Hicks, John R., 1985. Methods of Dynamic Economics. Oxford University Press, Oxford.

61 Houthakker, H. S., 1952. Compensated Changes in Quantities and Qualities Consumed. Review of Economic Studies, 19(50) :155-64.

62 Huang, Kuo S. and Richard C. Haidacher, 1989. "An Assessment of Price and Income Effects on Changes in Meat Consumption." In: Rueben C. Buse (ed.), The Economics of Meat Demand. Proceeding of the Conference on the Economics of Meat Demand. October 20 - 21, 1986, Charleston, South Carolina :139-56.

63 Innees, Robert D. and Gordon C. Rausser, 1989. "Incomplete Markets and Government Agricultural Policy." American Journal of Agricultural Economics, 71(4) :915-31.

64 International Monetary Fund (IMF), (various years). International Financial Statistics, Washington.

65 Ito, Takatoshi, 1980. "Methods of Estimation for Multi-Market Disequilibrium Models." Econometrica. 48(1) :97-125.

66 Ito, Takatoshi and Kazuo Ueda, 1981. "Tests of the Equilibrium Hypothesis in Disequilibrium Econometrics: An International Comparison of Credit Rationing." International Economic Review, 22(3) :691-708.

67 The Japan Times. "U.S. Beef to Face Road Blocks After Japan Lifts Quotas." Thursday, 12 October 1989.

68 Jarrat, I. S. Price-Quality Relationships in the Tokyo Beef Carcass Market: An Hedonic Price Analysis, MS Thesis, University of Queensland, Australia, 1987. Quoted in [97].

69 Johnson, Paul R., Thomas Grennes and Maria Thursby, 1979. "Trade Models with Differentiated Products." American Journal of Agricultural Economics, 61(1) :120-27.

70 Jorgenson, D. W. and J. J. Laffont, 1974. "Efficient Estimation of Nonlinear Simultaneous Equation with Additive Disturbances." Annals of Economic and Social Measurement, 3(4). :615-40.

71 Judge, Max D.; Elton D. Aberle; John C. Forrest; Harold B. Hedrick; and Robert A. Merkel, 1989. Principles of Meat Science.(2nd edn.). Kendall/Hunt Publishing Co., Iowa.

72 Khan, Linda, Sridhar Ramaswami and Steve Sapp, 1989. "Marketing Concerns". In: Marketing Meat in Japan: Preliminary Draft. The Second in the Series of Marketing Manuals. Midwest Agricultural Trade Research and Information Center (MATRIC), Ames.

73 Kravis, Irving and Robert Lipsey, 1978. "Pricing Behavior in the Light of Balance of Payments Theories." Journal of International Economics, 8(2) :193-246.

74 Koutsoyannis, A., 1987. Theory of Econometrics. (2nd edn.). Barnes & Noble Books: New Jersey.

75 Laffont, Jean-Jacques and Rene Garcia, 1977. "Disequilibrium Econometrics for Business Loans." Econometrica. 45(5) :1187-1204.

76 Lancaster, Kelvin, 1971. Consumer Demand: A New Approach. Columbia University Press. New York.

77 Langemeier, Larry and Russell G. Thompson, 1967. Demand, Supply and Price Relationships for the Beef Sector: Post World War II Period. Journal of Farm Economics, 49(1) :169-183.

78 Larue, Bruno and James Rude, 1989. "Quality Change and the Volume of Trade". Papers of the 1989 Annual Meeting of WAEA, Coeur D'Alene, Idaho. July 9-12, 1989. :567-74.

79 Lin, Biing-Hwan, Hiroshi Mori, James R. Jones and William D. Gorman, 1987. Effects of Trade Liberalization on Market Shares and Imports in the Japanese Beef Market. Selected Paper for Presentation at the AAEA Annual Meeting, Knoxiville, Tennessee, 31 July - 3 Aug, 1987.

80 Lin, Biing-Hwan, Hiroshi Mori, William D. Gorman and Neil R. Rimbey, 1989. An Analysis of the Japanese Demand for Beef and Some Implications of the New U.S. - Japanese Beef Agreement. Papers of the 1989 Annual Meeting of WAEA, Coeur D'Alene, Idaho. July 9-12, 1989. :559-66.

81 Lin, Biing-Hwan, H. Mori and W. Gorman. Implicit Values of Beef Carcass Characteristics in Japan and Its Implications for the U.S. - Beef Industry. Unpublished Paper, February, 1990.

82 Longworth, John W., 1983. Beef in Japan: Politics, production, Marketing and Trade. University of Queensland Press, St. Lucia.

83 Maddala, G. S., 1983. Limited Dependent and Qualitative Variables in Econometrics. Cambridge University Press, Cambridge.

84 _____, 1983. "Methods of Estimation for Models of Markets with Bounded Price Variations." International Economic Review, 24(2) :361-78.

85 _____, 1986. "Disequilibrium, Selfselection and Switching Models." In: Zvi Griliches and Michael D. Intriligator (eds.). Handbook of Econometrics, 3 :1633-87.

86 Marsh, John M., 1989. "Effects of a Beef Grade Change on Choice and Select Slaughter Cattle Prices." North Central Journal of Agricultural Economics, 11(2) :221-44.

87 Martin, Will, 1982. "Estimating the Impact of Beef Import Restrictions in the U.S. Import Market: Comment." Australian Journal of Agricultural Economics, 26(3) :233-7.

88 Mayer, Walter J., 1989. "Estimating Disequilibrium Models with Limited a Priori Price Adjustment Information." Journal of Econometrics, 41(3) :303-20.

89 Ministry of Agriculture, Forestry and Fisheries (MAFF), 1987. Abstracts of Statistics on Agricultural, Forestry and Fishery Products. Tokyo.

90 Ministry of Agriculture, Forestry and Fisheries (MAFF), Family Income and Expenditure Survey. (Various Years). Tokyo.

91 Ministry of Agriculture, Forestry and Fisheries. Statistical Yearbook (various years). Tokyo.

92 Mochini, Giancario and Karl D. Meilke, 1984. "Parameter Stability and the U.S. Demand for Beef." Western Journal of Agricultural Economics, 9(2) :271-82.

93 Mori, Hiroshi and William D. Gorman, 1985. "Issues, Facts and Opportunities for Exports of U.S. Beef to Japan". Agribusiness: An International Journal, 1(2) :211-18.

94 Mori, Hiroshi and William D. Gorman, 1987. " An Analysis of Japanese Demand for Beef: Imported and Domestic Beef". Senshu Economic Review, 22(2) Senshu University. Quoted in [96].

95 Mori, Hiroshi and William D. Gorman, 1987. "Representability of Tokyo Central Meat Wholesale Market Price Quotations for Beef Carcasses." Staff Report No. 54. Dept of Agricultural Economics and Agri-Business. New Mexico State University.

96 Mori, Hiroshi and William D. Gorman, 1989. "Quality Considerations in the Japanese Beef Market: Implications for Assessing Potential Imports Under Trade Liberalizaion". Senshu Economic Review, 23(2) :67-94.

97 Mori, Hiroshi, Biing-Hwan Lin and William D. Gorman, 1989. The New U.S. - Japanese Beef Agreement: Some Implications for the U.S. Beef Industry. University of Idaho, College of Agriculture, Agricultural Experiment Station Bulletin, No. 696.

98 Mori, Hiroshi, William D. Gorman and Biing-Hwan Lin, 1990. "Rates of Protection in the Japanese Beef Market." Paper presented at the 1990 AAEA Annual Meeting, August 3 - 8, University of British Colombia, Canada.

99 Muellbauer, John, 1978. Macro Theory vs Macro Econometrics: Treatment of Disequilibrium in Macro Models." Discussion Paper in Economics, no. 59. Birkbeck College, London. Quoted in [85].

100 Muellbauer, John and Richard D. Portes, 1978. "Macroeconomic Models with Quantity Rationing." Economic Journal, 87(352) :787-821.

101 Muellbauer, John and David Winter, 1980. "Unemployment, Employment and Exports in British Manufacturing: A Non-Clearing Markets Approach." European Economic Review, 13(3) :383-409.

102 Muth, John F., 1961. "Rational Expectations and the Theory of Pirce Movements." Econometrica. 29(1) :315-35.

103 National Livestock and Meat Board (NLMB), 1973. Meat Evaluation Handbook. Chicago.

104 Neville, W. E. Jr, O. M. Hale, Jr, L. W. Grimes and W. C. McCormick, 1976. "Factors Affecting the Sale Price of Three Breeds of Performance Tested Boars". Journal of Animal Science, 43(1) :20-26.

105 Organization for Economic Cooperation and Development (OECD), 1987. National Policies and Agricultural Trade: Country Study - Japan.

106 Patinkin, Don, 1965. Money, Interest and Prices. 2nd edition. Harper & Row, New York.

107 Pingetzer, Robert L., Dale J. Menkhaus, Glen D. Whipple and Ray A. Field, 1989. "The Influence of Selected Product and Demographic characteristics on Beef Purchasing Patterns". Papers of the 1989 Annual Meeting of WAEA, Coeur D'Alene, Idaho. July 9-12, 1989.

108 Pollak, Robert A., 1971. "Conditional Demand Functions and The Implications of Separable Utility." The Southern Economic Journal, 37(1) :423-33.

109 Purcell, Wayne D., 1989. "The Case of Beef Demand: A Failure by the Discipline". Choices: The Magazine of Food, Farm and Resource Issues. 4(2) :16-9.

110 Purcell, J. C. and F. W. Williams, 1989. "Historical Perspectives on International Trade Constraints and Liberalization". Journal of Agribusiness. 7(1) :1-3.

111 Quandt, Richard E., 1978. "Tests of the Equilibrium vs Disequilibrium Hypothesis." International Economic Review, 19(2) :435-52.

112 Ravallion, Martin, 1986. "Testing Market Integration." American Journal of Agricultural Economics, 68(1) :102-7.

113 Richard, J.F., 1980. "C-Type Distribution and Disequilibrium Models." Paper presented in the Toulouse Conference on "Economics and Econometrics of Disequilibrium." Quoted in [85].

114 Salop, Steve, 1973. "The Noisy Monopolist: Imperfect Information, Price Dispersion and Price Discrimination." Federal Reserve Board. Quoted in [115].

115 Salop, Steve, 1976. "Information and Monopolistic Competition." American Economic Review, 66(2) :240-45.

116 Simpson, J. R., Tadashi Yoshida, Akira Miyazaki and Ryohei Kada, 1985. Technological Change in Japan's Beef Industry. West View Press. Boulde. Quoted in [72].

117 der Sluis, Evert van and Dermot J. Hayes, 1989. An Assessment of the 1987 Japanese Beef Market Access Agreement on Beef and Feed Grain Markets. Paper Presented at the 1989 Annual Meeting of the AAEA, Baton, Rouge, Louisiana.

118 Sneessens, H., 1981. Theory and Estimation of Macroeconomic Rationing Models. Springer-Verlag, New York. Quoted in [85].

119 Sneessens, H., 1983. "A Macroeconomic Rationing Model of the Belgian Economy." European Economic Review, 20(1-3) :193-215.

120 Soken Co. Ltd., 1987. The Survey on American Meat Consumption Trend in Japan. Prepared for the U.S. Meat Export Federation. Quoted in [72].

121 Sweeney, James L., 1971. "Quality, Commodity Hierarchies and Housing Markets." Econometrica. 42(1):187-67.

122 Teal, Francis, Anderson Dickson, Darrell Porter and Diane Whiteford, 1987. Japanese Beef Policies: Implications for Trade, Prices and Market Shares. Occasional Paper, No. 102. Canberra.

123 Theil, H. 1952. "Qualities, Prices and Budget Inquiries". Review of Economic Studies, 29(3) :129-187.

124 Tomek, William G. and Kenneth L. Robinson, 1981. Agricultural Product Prices. (2nd edn.) Cornell University Press, London.

125 United States Department of Commerce, National Oceanic and Atmospheric Administration, and National Marine Fisheries Service. Fisheries of the U.S. 1987: Current Fishery Statistics No. 8700. Washington.

126 Wahl, Thomas I.; Gary W. Williams; and Dermot J. Hayes, 1987. Forecasting Changes in the Structure of the Japanese Meat Industry Under Alternative Beef Import Liberalization Scenarios. Paper Presented at the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management, St. Louis, April 26-7, Meat Export Research Center Report no. ES-1-87. Iowa State University, Ames.

127 Wahl, Thomas I., Dermot J. Hayes and Gary W. Williams, 1989. Dynamic Adjustment in the Japanese Beef Industry Under Alternative Import Policy Regimes. Department of Economics, Iowa State University. Ames.

128 Wahl, Thomas I., Gary W. Williams and Dermot J. Hayes, 1989. The 1987 Japanese Beef Market Access Agreement: A Forecast Simulation Analysis. Journal Paper No. J-14428 of the Iowa Agriculture and Home Economics Experiment Station, Ames.

129 Waugh, Frederick V., 1928. "Quality Factors Influencing Vegetable Prices." Journal of Farm Economics, 10(1) :185-96.

130 White, T. Kelley, 1989. "Policy Research Implications Under Trade Liberalization". Journal of Agribusiness, 7(1) :10-16.

131 Williams, Gary W., 1985. Japanese Livestock Markets and Policy: Implications for the U.S. Beef Exports. Meat Export Research Center (MERC) Staff Report No. 7-85. Iowa State University, Ames.

132 Wilson, William W., 1989. "Quality and Price Competition in the International Wheat Market". Papers of the 1989 Annual Meeting of WAEA, Coeur D'Alene, Idaho. July 9-12, 1989, : 575-83.

133 Wilson, William W., 1989. "Differentiation and Implicit Prices in Export Wheat Markets". Western Journal of Agricultural Economics, 18(1) :67-77.

134 Wohlgenant. Michael K., 1989. Effects of the Changing Composition of Beef Consumption on the Elasticities for Beef and Poultry. In: Rueben C. Buse (ed.). The Economics of Meat Demand, Proceeding of the Conference on the Economics of Meat Demand. October 20 - 21, 1986, Charleston, South Carolina.

135 Ziemer, Rod F. and Fred C. White, 1982. "Disequilibrium Market Analysis: An Application to the U.S. Fed Beef Sector." American Journal of Agricultural Economics, 64(1) :56-62.

136 ----------, 1982. "Equilibrium Versus Disequilibrium in the Market for Non-Fed Cattle." Western Journal of Agricultural Economics, 7(2) :163-72.

137 Zusman, Pinhas, 1967. "A Theoretical Basis for Determination of Grading and Sorting Schemes." Journal of Farm Economics, 49(1) :89-106.

APPENDICES

Appendix 1 Elasticities from Recent Studies

Eqn.	Dependent Variable	PRICE ELASTICITIES: Own	Cross: Pork	Poul	Fish	Dy beef	Wagyu	Expend. Elasticities	DATA: Period	Type	Source	Reference	SPECIFICATION: Model	Function	Technique	Other statistic: R^2	DW
1	Imported beef	-0.44 [1.63]	.38 [3.49]	.	-.07 [2.65]	1.14 [6.10]	.	3.3 [6.57]	1978(2) to 1987(2)	Quarter-ly	1,2,3	Lin, [32]	Quantity dependent	log-log	Single	0.885	2.12
2	Imported beef	-1.07 [5.56]	.25 [2.34]	.	-.05 [1.84] 1	1.38 [6.67]	.	1.9 na	"	"	"	"	Quantity dependent	log-log	Single	0.861	1.95
3	Dairy beef	-1.7 [9.67]	.10 [0.92]	.	.48 [3.94]		1.23 [4.51]	1.46 [8.42]	1978(2) to 1988(1)	"	1,2,3	Lin,[33]	Quantity dependent	log-log	Single	0.962	1.773
4	Wagyu beef	-3.76 [10.66]	.	.	1 .7 [4.33]	2.23 [8.42]	.	2.25 [14.9]	"	"	"	"	Quantity dependent	log-log	Single	0.936	1.72
5	Imported beef	-1.14 [3.88]	.77 [2.57]	.	.33 [0.96]	1.21 [2.40]	.98 [1.23]	2.67 [5.39]	"	"	"	"	Quantity dependent	log-log	Single	0.856	2.253
6	Consumption of beef	4 -1.13 [5,15]	.47 [2.19]	.24 [.7]	.58 [1.73]	.	.	1.26 [2.34]	1966-1986	Annual	1,4,5	Teal,[55]	Quantity dependent	log-log 1st diff	Single	0.66	2.04
7	High-quality beef	-.74 [.82]	.83 [2.57]	-.16 [-.32]	.77 [1.51]	.	.	-.23 [.28]	1966-1986	Annual	1,4,5	Teal,[55]	Quantity dependent	log-log 1st diff	Single	0.68	1.33
8	Low-quality beef	-1.65 [2.94]	.29 [1.22]	.49 [1.28]	.59 [1.57]	.	.	2.36 [3.98]	1966-1986	Annual	1,4,5	Teal,[55]	Quantity dependent	log-log 1st diff	Single	0.62	1.52
9	Beef's share in PFCE *	-.87	.15	-.13	.59	.	.	1.31	1966-1985	Annual	1,4,5	Teal,[55]	AIDS	Semi-log	System		
10	Wagyu's shar in PFCE *	-2.06	.95	.16	.47	.	.	1.42			6,7,8	Wahl,[59]	AIDS	Semi-log	System		
11	Import quality's	-1.0	.36	.11	.20	.	.	1.47			"	"	AIDS	Semi-log	System		

NOTES:
1 High valued fish 2 Imported beef price 3 Processed frsh
4 Low quality beef price 5 high quality beef price
6 Import quality prices 7 Wagyu prices
na Not applicable; Eqn. = equation

REFERECNCES:

1 Livestock Daily. Newspaper, Tokyo
2 MAFF, Statistical Report on Meat Marketing. Tokyo
3 MAFF, Monthly Statistics on Fishery Products Marketing. Tok
4 MAFF, (1986). The Meat Statistics in Japan. Tokyo
5 Bureau of Statistics, (1985). Annual Report on the Retail Survey
6 MAFF, Monthly Statistics of Agriculture, Forestry and Fishe
7 MAFF, Statistical Yearbook
8 MAFF, Statistics of Meat Marketing

Appendix 2. Mathematical Appendix

A2.1 Derivation of the Reduced form Price Equation.

Consider the following competitive market model.

$$[1] \quad D_t = \alpha_o + \alpha_1 P_t + \alpha_i' X + E_{1t}$$
$$[2] \quad S_t = \beta_o + \beta_1 P_t + \beta_j' Z + E_{2t}$$
$$[3] \quad D_t = S_t \qquad \text{(equilibrium condition)}$$

This represents the ideal (always clearing) Walrasian model. Successive price and quantity data (observed) lie on the demand and supply schedules, i.e. quantities are readily interpretable as desired quantities. The Derivation of the Reduced form Price Equation is:

1.01. $D_t = S_t$ (Identity [3])

1.02. $\alpha_o+\alpha_1 P_t+\alpha_i' X+E_{1t} = \beta_o+\beta_1 P_t+\beta_j' Z+E_{2t}$ (substituting [1] & [2])

1.03. $\alpha_o-\beta_o + \alpha_i' X-\beta_j' Z + E_{1t}-E_{2t} = \beta_1 P_t-\alpha_1 P_t$ (collecting terms)

1.04 $\alpha_o-\beta_o + \alpha_i' X-\beta_j' Z + E_{1t}-E_{2t} = (\beta_1-\alpha_1) P_t$ (factoring out P_t)

1.05 $(\beta_1-\alpha_1) P_t = \alpha_o-\beta_o + \alpha_i' X-\beta_j' Z + E_{1t}-E_{2t}$ (changing sides)

1.06. $P_t^* = (1/\beta_1-\alpha_1)\alpha_o-\beta_o + (1/\beta_1-\alpha_1)[\alpha_i' X-\beta_j' Z] + (1/\beta_1-\alpha_1)[E_{1t} - E_{2t}]$ (dividing both sides by $\beta_1-\alpha_1$)

1.07. $P_t = (1-\mu)(\alpha_o-\beta_o)/\beta_1-\alpha_1 + \mu P_{t-1} + \{(1-\mu)/\beta_1-\alpha_1\}\alpha_i X_i - \{(1-\mu)/\beta_1-\alpha_1\}\beta_j Z_j + \{(1-\mu)/\beta_1-\alpha_1\}[E_{1t} - E_{2t}]$ (substituting 1.06 into the price adjustment equation for P_t^*)

Appendix 2 (cont.)

A2.2 Derivation of the Structural Equations Corrected for Excess Demand.

Replace identity [3] above with the following minimum condition.

$$[4] \quad Q_t = \min (D_t , S_t)$$

and define desired quantity as the sum of transacted quantity and excess demand.

$$[5] \quad D_t , S_t = Q_t + (D_t - S_t)$$

Then the desired demand and supply schedules are derived from the regime of excess demand and excess supply respectively. First, let us consider the regime of excess demand, i.e. $D_t > S_t$.

2.01. $Q_t = S_t$ (by identity [4])

2.02. $D_t = S_t + (D_t - S_t)$ (by definition [5])

2.03. $D_t = Q_t + (D_t - S_t)$ (Substituting Q_t for S_t)

2.04. $D_t - (D_t - S_t) = Q_t$ (changing sides)

2.05. $Q_t = D_t - (D_t - S_t)$ (identical to 2.04)

2.06. $= D_t - (\alpha_o+\alpha_1 P_t+\alpha_i'X+E_{1t}-\beta_o-\beta_1 P_t-\beta_j'Z-E_{2t})$ (substituting [1] & [2])

2.07. $= D_t - (\alpha_o-\beta_o+\alpha_i'X-\beta_j'Z+E_{1t}-E_{2t}+\alpha_1 P_t-\beta_1 P_t)$ (collecting terms)

$= D_t - (\alpha_o-\beta_o+\alpha_i'X-\beta_j'Z+E_{1t}-E_{2t}+(\alpha_1-\beta_1) P_t)$ (factoring out P_t)

2.08. $= D_t - (\alpha_o-\beta_o+\alpha_i'X-\beta_j'Z+E_{1t}-E_{2t}) + (\beta_1-\alpha_1) P_t$ (taking the last term out of the bracket. This changes β and α in position)

2.09 $Q_t = D_t - \{(\beta_1-\alpha_1) P_t^*\} + (\beta_1-\alpha_1) * P_t$ (using 1.06 above)

2.10. $= D_t + (\beta_1-\alpha_1) P_t - \{(\beta_1-\alpha_1) P_t^*\}$ (changing terms)

2.11. $= D_t + (\beta_1-\alpha_1)(P_t - P_t^*)$ (factoring out)

2.12. $Pt = \mu Pt-1 + (1-\mu) Pt^*$ (price adjustment)

2.13. $P_t = \mu P_{t-1} + P_t^* - \mu P_{t*}$ (multiplying out)

2.14. $P_t - P_{t*} = \mu P_{t-1} - \mu P_{t*}$ (collecting terms)

2.15. $P_t - P_{t*} = \mu (P_{t-1} - P_t^*)$ (factoring out)

2.16. $Q_t = D_t + (\beta_1-\alpha_1)\mu(P_{t-1} - P_t^*)$ (substituting for $P_t - P_t^*$ in 2.11)

2.13.' $P_t = \mu P_{t-1} + P_t^* - \mu P_{t*}$ (same as 2.13)

2.17. $P_t - P_{t-1} = \mu P_{t-1} - P_{t-1} + P_t^* - \mu P_t^*$
(subtracting P_{t-1} from both sides)

2.18. $P_t - P_{t-1} = P_t^* - \mu P_t^* - P_{t-1} + \mu P_{t-1}$
(collecting terms)

2.19. $P_t - P_{t-1} = (1-\mu) P_t^* - (1-\mu) P_{t-1}$
(factoring out variables)

2.20. $P_t - P_{t-1} = (1-\mu)(P_t^* - P_{t-1})$
(factoring out $1-\mu$)

2.21. $1/1-\mu(P_t - P_{t-1}) = P_t^* - P_{t-1}$
(dividing both sides by $1-\mu$)

2.22. $Q_t = D_t + (\beta_1 - \alpha_1)\ (\mu/1-\mu)\ (P_t - P_{t-1})$
(substituting the left side of 2.21 for $P_{t-1} - P_t^*$ in 2.16)

NOTE ON APPENDIX A2.2:

1. The last substitution assumes "equality" or similarity in statistical property between $P_{t-1} - P_t^*$ in 2.16 and $P_t^* - P_{t-1}$ in 2.21. This will hold if one of these is multiplied by - 1. Since this is the case in the supply equation, the substitution is accepted as valid.

2. The desired supply schedule can be derived in a similar fashion beginning with the excess supply regime, regime 2.

3. After adjustment we have:

$$D_t = \alpha_{m-2} + \alpha_{m-1} P_t + \Sigma \alpha_m X_{mt} + \alpha_{m+1} P_t^+ + E_{1t}$$
$$S_t = \beta_{j-2} + \beta_{j-1} P_t + \Sigma \beta_j Z_{jt} + \beta_{j+1} P_t^- + E_{2t}$$

and where:

$$P_t^+ = \begin{cases} P_t - P_{t-1} & \text{if } P_t > P_{t-1} \\ 0 \quad \text{otherwise} \end{cases}$$

$$P_t^- = \begin{cases} (-1)^* P_t - P_{t-1} & \text{if } P_t < P_{t-1} \\ 0 \quad \text{otherwise} \end{cases}$$

$$\beta_{m+1} = \{\mu\ (\beta_1 - \alpha_1)\}/(1-\mu)$$
$$\beta_{j+1} = \{\mu\ (\beta_1 - \alpha_1)\}/(1-\mu)$$

Appendix 3. Notes on Data Sources

A3.1 Market I

Source: 1) Monthly Statistics of Japan
2) Statistical Year Book of Japan

Released by: Statistics Bureau, Management and Coordination Agency

Frequency & Outlet .... Same as "Sources" above.

Other Notes:

1) General Notes:

The data contained in this source are compiled from different original sources. Such sources are given under each commodity group table. Retail price data for beef, pork and chicken used for Market I are available in the "Prices" section. Original source the Statistical Bureau itself.

2) Types of Prices:

Retail

3) Geographical coverage:

Ku-area of Tokyo

Appendix 3 (cont.)

A3.2 Market II

Source: The Family Income and Expenditure Survey (FIES)

Released by: Statistics Bureau of Management and Coordination Agency of Japan

Frequency & Outlet: Monthly: "Monthly Report on the Retail Price Survey."
Annually: "Annual Report on the Retail Price Survey."

Purpose: Obtaining nation-wide information on retail prices of goods and services which will ultimately be used in compiling consumer price indices (CPI) and other statistics used in economic policy making.

Other Notes:

1) Who collects price information?

Retail prices of the products considered in this study are surveyed by non-government enumerators designated permanently in each sample city, town and village or commonly called survey district. The enumerators visit price reporters and pick the price information. To qualify for a price reporter, one has to be retail store or service establishment manager.

2) Commodity specification.

Detailed specifications of each survey item are given to enumerators scattered nation-wide. Such specification however are updated annually.

3) Types of prices collected.

Only "Normal" price are collected. This means that low prices due to discounts for one reason or another and high price caused by seasonal

festivals and others are excluded.

4) How frequent are these prices collected?
Every week (Monday, Wednesday or Friday). Prices on three consecutive days ending with the survey date are collected and only the median price is recorded.

5) Averaging.

The monthly average retail prices of a product in a survey district is the simple arithmetic mean of median prices collected during each week. The simple arithmetic mean of monthly average prices over a year yield the annual average prices.

6) Geographical coverage.

Nation-wide but prices are location specific and presumed to vary across districts. There is no tacit statement on what explains such differences. I suggest that, at least, three factors may be responsible for geographical differences in time specific retail prices of the same product. These are (a) differences across districts in the degree to which government price stabilization policy is implemented, (b) differences in the extent of market integration between each of the district markets with the Tokyo and Osaka central markets where government is directly exercising its price stabilization policy, and (c) differences in local market forces.

Appendix 4. Data Set Used in the Analysis

A4.1 Market I

Year	Quantity (kg/head)	Retail Prices of: Beef* (¥/kg)	Pork* (¥/kg)	Chicken (¥/kg)	Fish (¥/kg)
1965	1.73000	26.27692	22.92308	22.09231	8.16400
1966	1.24000	30.79179	20.35191	21.23167	8.18680
1967	1.28000	34.92958	20.11268	20.50704	8.85690
1968	1.40000	37.96791	22.70053	19.89305	9.48690
1969	1.87000	34.26396	24.36548	18.98477	10.15305
1970	2.04000	32.38771	21.48936	18.13239	11.21891
1971	2.25000	32.66667	20.66667	15.82222	12.21022
1972	2.46000	31.99153	21.01695	15.33898	12.73729
1973	2.36000	37.57116	21.25237	15.19924	13.09127
1974	2.42000	37.69231	19.07692	14.76923	12.88538
1975	2.40000	37.32782	21.34986	13.77410	13.10000
1976	2.43000	39.79849	21.15869	13.97985	13.47531
1977	2.66000	36.67055	18.50990	12.10710	14.01513
1978	3.02000	34.52514	17.54190	11.50838	14.01050
1979	3.14000	33.94397	16.16379	10.70043	14.16412
1980	3.13000	33.90000	14.50000	11.40000	13.80710
1981	3.42000	32.03051	14.58532	11.43947	13.77455
1982	3.51000	31.72542	14.56401	10.94620	14.22811
1983	3.64000	31.93813	14.83167	10.82803	13.58253
1984	3.86000	31.78985	14.60374	10.41852	13.23437
1985	3.99000	30.62827	13.43805	10.03490	13.35977
1986	4.12000	30.61578	13.00954	9.62706	13.87285

---

* medium grade prices

Appendix 4 (cont.)

A4.2 Market II

Year	Quantity (kg/hhld*)	Retail Prices of: Beef (¥/kg)	Pork (¥/kg)	Chicken (¥/kg)	Fish** (¥/kg)
1965	8.36100	22.79692	20.18769	18.04923	7.58154
1966	6.87000	26.16422	18.55718	17.74194	7.59531
1967	6.04000	28.63380	18.25070	17.00563	8.18310
1968	5.73400	29.93850	19.72460	16.87968	8.69519
1969	6.34900	29.52538	21.24112	16.31980	9.34772
1970	6.78200	28.72813	19.40662	15.28132	10.44917
1971	7.24300	28.68222	18.78667	15.07333	11.50444
1972	7.70800	29.84110	19.16737	14.54661	12.05297
1973	7.05100	34.85199	19.29032	14.80076	12.23340
1974	7.42300	32.65077	17.44615	14.45385	12.13846
1975	7.78400	32.85124	19.07989	14.11157	12.43664
1976	8.04500	33.66247	18.96474	13.98866	12.85642
1977	8.39000	31.75087	17.03958	12.90687	13.34459
1978	9.31500	30.77989	16.10615	11.37542	13.24022
1979	9.42500	30.65625	14.82220	10.49677	13.36207
1980	9.15300	30.93400	13.72000	9.91100	12.92900
1981	9.41000	29.55100	14.02860	9.92660	12.88942
1982	9.85400	29.16327	13.92857	9.56586	13.26252
1983	9.68700	28.57871	13.96451	9.30664	12.67152
1984	10.05000	27.79074	13.57524	9.03918	11.88691
1985	9.81800	27.83944	12.93019	8.56806	12.53054
1986	9.91200	27.85516	12.32611	8.21683	12.63920

---

* hhld = household

** fresh and shellfish prices

Appendix 4 (cond.)

A4.3 Both Markets

Year	PCE*	CFC*	BIP*	WDF*
1965	193901.7	4317.477	7.084150	1268.660
1966	221034.2	5003.783	8.260784	1313.200
1967	250957.1	5866.620	9.982038	1472.300
1968	283650.5	6185.909	9.346943	1611.730
1969	323068.7	6407.462	7.625317	1600.600
1970	367385.5	6003.570	8.138123	1655.800
1971	408987.7	5405.556	8.737575	1719.600
1972	465537.8	5427.881	8.857050	1807.800
1973	554760.4	5433.719	11.91318	1840.400
1974	661873.6	6186.092	1.131348	1799.700
1975	759729.3	7514.848	3.627182	1803.300
1976	849374.8	6370.516	6.623961	1908.700
1977	940418.1	6265.134	5.062356	2000.300
1978	1026310.0	6525.966	5.214605	2079.700
1979	1122620.0	6306.724	7.404872	2283.050
1980	1210173.0	6282.060	8.161572	2295.400
1981	1269741.0	6938.904	6.852596	2381.300
1982	1347455.0	7186.382	7.406809	2449.800
1983	1407085.0	6745.505	7.005013	2530.000
1984	1466289.0	6048.085	6.614676	2570.000
1985	1527346.0	5698.726	6.469892	2649.700
1986	1579768.0	5530.312	4.549178	2659.000

---

* PCE = private consumption expenditure (mil. ¥/head)
CFC = young stage cattle fattening cost (¥/head)
BIP = beef import price, cif (¥/kg)
WDF = wagyu and holstein cattle on feedlots (1000s)