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Competition in the Japanese Potato Market

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October, 1997

A Thesis Submitted to the Faculty of
Graduate Studies and Research in partial fulfillment
of the requirements for the degree of Master of Science

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0-612-44181-4
The Japanese vegetable market is characterized by a general tendency towards the concentration of production by region. Amongst all vegetables, potato production has the highest level of concentration. Eighty-six percent of the total market quantity is accounted for by Hokkaido, the largest production prefecture amongst the 47 prefectures in Japan. The Herfindahl Index for prefectures in the Japanese potato market was 0.74 in 1994, indicating that the fewness of producers was equivalent to a market where total output was shared equally by only 1.35 producers. Under this highly concentrated situation, existence of monopolistic power, or more generally, oligopolistic power, of the large scale producers can be suspected.

In this thesis, the level of competition in the Japanese Potato market was evaluated employing conjectural variations analysis based on a monthly data for 1989 to 1995 to reveal the nature of the market. Four wholesale markets, in four large consumption areas, and eight production areas in different geographical locations in were analyzed.

The conclusion from the results of the empirical analysis is that, despite the high level of concentration in production, all producing regions including the dominant producer, Hokkaido, seem to have behaved competitively.

One implication for the competitive behavior of these large producers is the imperative to maintain their share in the market against potential competitors, resulting in price setting close to the marginal cost.
RÉSUMÉ

Le marché Japonais des légumes est caractérisé par une tendance générale vers une concentration de la production par région. Parmi toutes les légumes, la production des pommes de terre a le plus haut niveau de concentration. Quatre vingt et six pour cent de la quantité totale du marché Japonais est transigée à Hokkaido, par ce fait, elle est la plus grande préfecture productrice parmi les 47 préfectures du Japon. L'Index Herfindahl pour les préfectures dans le marché Japonais des pommes de terre était de 0.74 en 1994, ce qui indiquait que le peu de nombre de producteurs était équivalent à un marché dans lequel la production totale était partagé équitablement entre 1.35 producteurs. A cause de cette haute concentration, la possibilité de l'existence d'un pouvoir monopolistique, ou plus généralement, un pouvoir oligopolistique a été soupçonnée.

Dans cette thèse, l'évaluation du niveau de competition dans le marché Japonais des pommes de terre a été faite en utilisant l'analyse de la variation conjoncturelle basée sur des données mensuelles de 1989 à 1995 et ce pour révéler la nature du marché. L'analyse a été faite sur quatre marchés de gros, quatre grandes régions de consommation et huit régions de production dans différentes locations géographiques.

En conclusion et à partir des résultats de l'analyse empirique, il s'est avéré que malgré le niveau de concentration de la production, les producteurs se comportent d'une façon compétitive, ceci est vrai aussi pour le producteur dominant (Hokkaido).
Une implication d'un tel comportement de la part de ces grands producteurs est leur intérêt impératif à maintenir leur part du marché face à d'éventuels compétiteurs potentiels, en conséquence, les prix de la pomme de terre est proche du coût marginal de transport.
Acknowledgments

I am thankful to my supervisor, Dr. Garth Coffin for his tremendous support and consideration throughout two years of my program, especially in his tight schedule as an administrator in two schools. I thank Dr. Kisan Gunjal for always giving me constructive suggestions and encouragement closely throughout my thesis work.

I am extremely grateful to Takashi Kato, the chairman of Musashino Group, Japan, for his financial and moral support.

I am grateful to Dr. John Henning for encouraging me to come to McGill. I thank Dr. Peter Goldsmith; Dr. Tomoyoshi Matsuda, Chiba University, Japan; Dr. Toshinobu Matsuda, Hokkaido University, Japan, for their helpful suggestions.

I thank Mr. Keith Waddington, the Department of English Literature, Concordia University, for his skilled and sincere work in editing and correcting my articles. I am thankful to the administrative assistants of the department, Pat and Janet. I thank all the staffs and colleagues in McGill University especially Urm; Hassan and his wife, Rosanna; Sacha; Michael; Tony Gupta; Stephen Primeau.

I thank the following people and organizations for their help in field work and data collection, which enabled me to shape the concept of this thesis: Katsuhiro Ishi, Eiji Horigome, Tatsuhiko Sugino, Mr. Hayashi and Mr. Setouchi, M.A.F.F.; Gohta Nishimura, Toyo-Keizai; Takayuki Tanaka, I.C.U.; Sakutake Shirayama, Hiroaki Higashi, Yukihito Hoku and Minoru Futuri, Tokunoshima Town Government; Seijiro Inori and Mr. Okamura, Amagi Town Government; Mr. Saruban, Mr. Takenouchi and Mr. Satonaka, Kagoshima Prefecture; Mr. Nirei
and Mr. Hirayama, JA Tokunoshima; Mr. Suyama, Mr. Akita and Mrs. Inamura, 
JA Amagi; Akira Shirayama, Nansei-Togyo; Toru Toki, Tokiwaya Seika; Ikegami 
Reiichiro, Ikegami No-san; Mr. Mikami and Mr. Oshima, Tokyo Central 
Wholesale Market; Mayumi Masaki and Kiyomi Inda; Tatsuya Hiroo, 
Bridgestone Tire; Tokunoshima Judo Association.

I am thankful to my family, ex-wife and children for their support and 
understanding.

I am grateful to Kohnosuke Hagihara for his tremendous moral support. I 
thank Hiroshi Nakamura Sensei, Shidokan, Montreal, for encouragement in my 
life in Canada.

I would especially like to thank Tomomi Matsuo for courage she has given 
me.

I also thank following undergraduate students of McGill, who made my 
second university life more meaningful and responsible: Adytia, Charlie, David, 
Kaoru and Wataru.

Last but not least, I thank Marie-Clare.
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1.1 Introduction

Subsequent to the final agreement of the Uruguay round of GATT(URG) in 1993, reduced economic intervention by member governments and a tendency towards freer trade are considered to be firmly entrenched under new international trading rules. In this new open arena of international trade, efficient production and marketing systems are essential to maintain healthy regional agricultural systems in nations vulnerable to imports. Even without the pressure of free trade, it is important to seek ways to improve the efficiency of production and marketing systems for any country.

In discussing both empirical production studies and market efficiency, it is necessary to examine whether the fundamental assumptions upon which such studies are based offer a fair representation of reality. The implicit assumption of perfectly competitive markets, whereby all economic agents are price takers and attain their optimization under given prices, is one such example.

Vegetables in Japan, for instance, have been produced and distributed over wider areas as a result of progress in transportation and reduction of suburban production areas during periods of high economic growth. Simultaneously, highly concentrated large scale production areas for a variety of vegetables, such as Hokkaido, have risen. As Matsuda and Kurokawa (1996) explain, one reason for this concentration of production and shipment was a
deliberate administrative selection of production centers, attributed to the Designated Vegetable Producing Area System (Yasai Shitei Sanchi Seido) established under the Vegetable Production and Shipment Stabilization Act (Yasai Seisan Shukka Anteiho).

Under this circumstance with concentrated production, markets may display qualities of imperfect competition. In this case, markets are generally characterized by oligopolistic behavior, making the price taking hypothesis as inappropriate as it is inaccurate (Appelbaum, 1982). Cases in which the degree of competition in certain markets is unknown require careful estimation or the testing of an alternative hypothesis rather than maintaining the supposition of price-taking behavior.

The main focus of this thesis is, therefore, to test the existence of imperfect competition in the Japanese potato market. With more than 90% of the potato production concentrated in four prefectures, considering the Japanese marketing system, this industry indeed exhibits structural characteristics similar to those of oligopoly.

One methodology by which the degree of oligopolistic power in the markets can be measured is a conjectural variation: the percentage change in all other shipper's output expected by any given shipper in response to a one percent change in its own output. The oligopolistic power and the possibility of collusion among shipping entity in the Japanese potato market will therefore be tested based on the estimation of conjectural variation.


1.2 Japanese Potato Market Issues

There are several reasons why the Japanese potato market is selected as an important subject of examination.

Firstly, the production of potatoes is highly concentrated in several production areas. Secondly, they can be stored relatively longer than most perishable vegetables. The potatoes are pre-cooled, which is called “yorei,” and then shipped throughout the year from various production areas. Thirdly, due to geographical characteristics, tremendous climatic differences exist amongst these regions of production. While Hokkaido, the dominant production area of potatoes, is covered with snow for almost half the year and is able to ship only stored products, other areas temporally have opportunities to ship their fresh products to markets during that period. Fourthly, the quantity of potatoes supplied to the market is the largest amongst all vegetables. Therefore potatoes hold a very important place in the Japanese vegetable market.

The Herfindahl Index—a measure of fewness of producers—of potatoes in Japan is 0.7384, equivalent to that of markets where only 1.3 producers equally share the whole shipment. However, if the market situation is examined throughout the year, fluctuations in the degree of imperfect competition appear with implications regarding the nature of the market structure.

Further descriptions of the market situation are shown with statistical data in Chapter Two.
1.3 Hypothesis, Purpose and Objectives

1.3.1 Hypothesis

Existence of imperfectly competitive behavior in the Japanese potato industry is the hypothesis of this research. Conjectural variation, one method used as a measure of the degree of competition in a market with oligopolistic power, is employed to test the hypothesis.

1.3.2 Purpose and Objectives

The primary purpose of this study is to investigate the existence of oligopolistic power in the Japanese potato market concerned. To do so, the statistical properties of the estimator for the conjectural variation are examined.

The main objectives of the thesis are:

1. To develop a descriptive analysis of the markets and their structure.
2. To investigate the degree of competition in the Japanese potato markets by estimating conjectural variation in some of the main wholesale markets.

1.4. Structure of the Thesis

This introductory chapter has presented the research problem, the hypothesis and the main objectives of the thesis. Chapter Two provides a descriptive analysis of the Japanese potato market along with a description of the Japanese food market as a whole. Chapter Two also describes the structural characteristics of vegetable trading in Japan, as well as the historical
background which explains the emergence of the highly concentrated production areas for various agricultural products. It also explains why prefectures are treated synonymous with single producers.

Chapter Three provides a review of the literature relevant to the study.

Chapter Four describes the development of the methodology and empirical analysis. The estimation of conjectural variation is described in detail.

Chapter Five presents and interprets the results of the empirical analysis.

Finally, Chapter Six concludes the thesis with a summary of the limitations of the analysis and recommendations for further studies.
CHAPTER TWO
DESCRIPTIVE ANALYSIS OF THE JAPANESE POTATO MARKET

2.1 Introduction

The Japanese agricultural market is characterized by a tendency to concentrate the production and shipping of vegetables in large production centers. The objective of this chapter is to develop a descriptive analysis of the Japanese vegetable market with emphasis on the structural, legislative and local factors responsible for this concentration.

In assuming the possibility of oligopolistic powers of the large scale production centers, we must presume that the products can be transferred throughout Japan. Since the rational wholesale market system is closely related to this assumption, this chapter will also provide a description of that system.

2.2 Agricultural Regions of Japan

Japan, an island nation situated off the east coast of the Asian continent, is composed of four large islands—Hokkaido, Honshu, Kyushu and Shikoku—and approximately 7,000 remote islands extending in an arc of about 3,000 kilometers northeast to southwest from 45° 33' to 20° 25'. The total land area covers 377,750 square kilometers. The southern part of the country is situated in the tropical zone, the middle area in the temperate, and the northern area in the subarctic zone. The extensive variations in geographical characteristics and
climate which result from these topographical conditions allow for a broad variety of agricultural regions. Figure 2.1 shows the geographical extent of Japan.

Figures 2.2 and 2.3 show the monthly mean temperature and precipitation in four Japanese cities: Sapporo, Tokyo, Fukuoka and Naha, which are located in three of the main islands—Hokkaido, Honshu and Kyushu respectively—and in one remote area. The wholesale markets in those four cities will be objects of the analysis in this thesis.

According to the Ministry of Agriculture, Forestry and Fisheries of Japan, the agricultural areas in Japan are classified into 10 regions. The names of the prefectures included in these regions are shown in Table 2.1.

For the purpose of this research, prefectures are treated as production areas. Hence, we suppose that the Japanese vegetable market consists of 47 domestic producers. The legislative bodies enhancing agricultural production and shipment are basically organized by prefectures. In wholesale markets, the origin of products are also generally recognized by prefectures. The co-shipment—products and accounts of producers are pooled together—of vegetables by agricultural co-operatives (JA) is planned and adjusted by prefectural organizations (Ken-Keizairen). It is therefore reasonable to consider a prefecture as a unit of production area. Studies done by Kanayama (1994) and Kobayashi (1986) also regarded prefectures as production areas.

---

1 The description is mainly based on Japan Almanac 1995.
2 The data availability is limited to prefectures since M.A.F.F. statistics are generally organized according to prefectures.
Figure 2.1: Agricultural Regions of Japan

Northern Limit
45.33 degrees north

Southern Limit
20.25 degrees north
Figure 2.2: Monthly Mean Temperature of the Four Cities

Monthly Mean Temperature (1961-1990)

(Source: Chronological Scientific Tables, 1993)

Figure 2.3: Monthly Mean Precipitation of the Four Cities

Monthly Mean Precipitation (1961-1990)

(Source: Chronological Scientific Tables, 1993)
2.3 Concentration of Vegetable Production in Japan

As noted earlier, Japanese vegetable production is highly concentrated by region. In the case of potatoes, for example, Hokkaido accounts for 86% of all shipments. For other crops, Hokkaido's figures are: onions, 50%; and pumpkins 49%.

An objective measure for the degree of concentration across the different crops is useful in order to appreciate the relative degree of concentration in potatoes. In Table 2.2, the Herfindahl Index, usually applied as a measure of concentration in an industry, is shown, along with the ratio of the four largest producers (CR4).
Table 2.2: Indices of Prefectural Concentration in the Japanese Vegetable Market in 1994

<table>
<thead>
<tr>
<th>Crop</th>
<th>Herfindahl Index</th>
<th>Number Equivalent=1/H=</th>
<th>CR4 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potatoes</td>
<td>0.7384</td>
<td>1.35</td>
<td>92.50</td>
</tr>
<tr>
<td>Onions</td>
<td>0.3072</td>
<td>3.25</td>
<td>72.66</td>
</tr>
<tr>
<td>Pumpkins</td>
<td>0.2613</td>
<td>3.83</td>
<td>70.38</td>
</tr>
<tr>
<td>Yams</td>
<td>0.2351</td>
<td>4.25</td>
<td>77.05</td>
</tr>
<tr>
<td>Lettuces</td>
<td>0.1658</td>
<td>6.03</td>
<td>61.42</td>
</tr>
<tr>
<td>Carrots</td>
<td>0.1418</td>
<td>7.05</td>
<td>38.00</td>
</tr>
<tr>
<td>Sweet Peppers</td>
<td>0.1268</td>
<td>7.89</td>
<td>63.67</td>
</tr>
<tr>
<td>Chinese Cabbages</td>
<td>0.1248</td>
<td>8.01</td>
<td>57.95</td>
</tr>
<tr>
<td>Turnips</td>
<td>0.1211</td>
<td>8.26</td>
<td>52.46</td>
</tr>
<tr>
<td>Edible Burdocks</td>
<td>0.1080</td>
<td>9.26</td>
<td>58.97</td>
</tr>
<tr>
<td>Taros</td>
<td>0.0988</td>
<td>10.12</td>
<td>54.24</td>
</tr>
<tr>
<td>Welsh Onions</td>
<td>0.0714</td>
<td>14.01</td>
<td>46.62</td>
</tr>
<tr>
<td>Cabbages</td>
<td>0.0684</td>
<td>14.62</td>
<td>43.82</td>
</tr>
<tr>
<td>Japanese Raddish</td>
<td>0.0552</td>
<td>18.12</td>
<td>37.83</td>
</tr>
<tr>
<td>Spinaches</td>
<td>0.0550</td>
<td>18.18</td>
<td>38.64</td>
</tr>
<tr>
<td>Cucumbers</td>
<td>0.0486</td>
<td>20.58</td>
<td>36.57</td>
</tr>
<tr>
<td>Eggplants</td>
<td>0.0485</td>
<td>20.62</td>
<td>32.04</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>0.0442</td>
<td>22.62</td>
<td>31.96</td>
</tr>
<tr>
<td>Equally distributed to 47 prefectures</td>
<td>0.0213</td>
<td>47</td>
<td>8.51</td>
</tr>
</tbody>
</table>

(Source: The 71st Statistical Yearbook of M.A.F.F., 1994-95)

The Herfindahl Index is a measure of fewness\(^1\) defined as

\[ H = s_1^2 + s_2^2 + s_3^2 + \ldots + s_N^3 \]

where \( N \) is the number of firms in an industry and \( s_i \) is the market share of firm \( i \).

If a market is supplied by a monopolist, the \( H \)-index is 1. If the market is shared equally by all \( N \) firms, the \( H \)-index is \( 1/N \). If the share is equally distributed to all of the 47 prefectures of the Japanese vegetable market, the \( H \)-index would be 0.0213.

\(^1\) The definition and terminology used here are based on Martin, S. (1993)
Numbers of Equivalent in the table are the inverse of H-index. 1/H shows that the distribution of production is equivalent to the condition where the share is distributed equally to 1/H producers.

From the table, it can be seen that the production of some vegetables—such as onions and pumpkins—is highly concentrated. Amongst all vegetables in Japan, the production of potatoes is the most concentrated. The Number of Equivalent for potatoes is 1.35, which is very close to the value for a monopoly situation. In this research, the degree of competition of potatoes is further investigated.

2.4 Factors Influencing the Concentration of Vegetable Production in Japan

2.4.1 Competition among Production Areas

Large scale production centers of vegetables in Japan have been formed through competition amongst production areas. There are several reasons why competition has accelerated and lead to the formation of these large scale production centers.

According to Hotta (1995), throughout the 1960s and 70s, an extensive flow of population from agricultural or rural areas to large cities under the influence of rapid economic growth meant that the implicit food demand once consumed in farm households was transformed as the demand in the market system. To deal with this developing situation, the government implemented the Wholesale Market Law (Oroshiuri-Shijo-Ho) in 1971. This law sought to organize the market system throughout Japan. The number of local markets decreased by one-third, to 1,600. In the place of those local markets, 91 central wholesale
markets were established in 56 cities based on the guidelines implemented through this law. (Yamamoto, 1986)

As a result of this re-organization of the market system, the following conditions have become necessary for both traders and producers in the market: 1. mass volume trading, 2. stability of supplied quantity and 3. homogeneity of quality and category of products. Consequently, small scale shipments by individual farmers became disadvantaged. Hence, to plunge into this mass trading and mass consumption system, the producers formed large production centers, such as Nagano Prefecture for high latitude and cool temperature vegetables, Ehime Prefecture for citrus and Nara Prefecture for strawberries. (Hotta, 1995)

The development of efficient transportation eliminated the constraint of distance; improvement in farming, storage and packing facilities reduced the time lag between shipment and consumption. These improvements led to the transfer of production areas from those around large cities to more remote areas. These remote areas in turn developed into large scale production centers. (Yamamoto, 1986)

In summary, two predominant forces increased competition among producers: the increase of demand in large urban areas, with system requirements for stable and mass quantity supply; and technology such as transportation and storage, which has effectively enlarged the area of competition.
Under these circumstances, Kanayama (1994) suggests that the purely competitive market structure of the Japanese vegetable market has gradually transformed into one with imperfect characteristics. Since 1975, with excess supply becoming common in the market, the consumers’ tendency to seek high quality products has become conspicuous, correspondingly enlarging the sales share of large scale wholesalers. Hence, as Kanayama explains, it has become increasingly important to consider the imperfect market in the analysis of the demand structure of vegetables in Japan. However, Kanayama also mentions that not all vegetable markets operate under imperfect competition, emphasizing the necessity to confirm the existence of vegetables under imperfect competition and to empirically analyze price determinations and fluctuations of these kinds of vegetables.

2.4.2 The Factors of Competition

In his study of the Japanese vegetable market, Hotta (1995) suggests that the competitiveness of a production area in respect of a particular product is dependent upon profitability and the possibility of increased profits from the product in the area. He also points out that the competitiveness can be categorized into both internal and external factors.

The internal factors are the comparative level of applied technology to grow the product and immobile resources of the production area, such as farm land. The external factors are the feasibility of growing a product and the
possible increase in demand for it in the future. The short-run indicator of
demand can be price elasticity of demand for the product. (Hotta, 1995)

As a whole, the long term profitability of a certain product in a production
region can be described as the profit per area. Concerning a product, a
production region can grow into a large scale production center when a large
profit per area exists with the possibility of future increase.

The long term profitability of each agricultural product in production areas
can be described in comparison with an average profit per area of all the
competing production areas. That is, in an equation,

\[ D_{ij} = \frac{P_{ij}/C_{ij}}{P_i/C_i} \cdot \frac{Q_{ij}}{Q_i} = \frac{P_{ij}}{P_i} \cdot \frac{C_i}{C_{ij}} \cdot \frac{Q_{ij}}{Q_i}, \]

where

- \( D_{ij} \): the index of competitiveness of the \( i_{th} \) production area in terms of the
  \( j_{th} \) product
- \( P_{ij} \): farm gate price of the \( j_{th} \) product in the \( i_{th} \) production area
- \( Q_{ij} \): yield of the \( j_{th} \) product in the \( i_{th} \) production area
- \( P_i \): average farm gate price of \( j_{th} \) product in all the competing production
  areas
- \( Q_i \): average yield of the \( j_{th} \) product in all the competing production areas
- \( C_{ij} \): production cost of the \( j_{th} \) product in the \( i_{th} \) production area
- \( C_i \): average production cost of the \( j_{th} \) product in all the competing
  production areas.
One estimation for this long term profitability for potatoes is, for Hokkaido, $D=10.0$ and for prefectures except Hokkaido, $D=1.65^1$.

In the last section, we saw that potato production in Japan is the most concentrated among all vegetables. In Table 2.3 and Figure 2.4, the most dominant producers are shown by prefecture. The greatest producer is Hokkaido, which has approximately 86% share of the entire production.

Table 2.3: The Share of Japanese Potato Production (1994)

<table>
<thead>
<tr>
<th>Prefecture</th>
<th>Shipping (kg)</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hokkaido</td>
<td>2,285,000</td>
<td>0.8581</td>
</tr>
<tr>
<td>Nagasaki</td>
<td>89,900</td>
<td>0.0338</td>
</tr>
<tr>
<td>Kagoshima</td>
<td>52,400</td>
<td>0.0197</td>
</tr>
<tr>
<td>Ibaragi</td>
<td>36,000</td>
<td>0.0135</td>
</tr>
<tr>
<td>Chiba</td>
<td>32,500</td>
<td>0.0122</td>
</tr>
</tbody>
</table>


Figure 2.4: The Share of Japanese Potato Production (1994)

1 In this rough estimation, the wholesale market price is used as farm gate price. The cost and yield for prefectures except Hokkaido are estimated for only selected prefectures. Moreover, those investigations are done by each prefecture independently without common criteria among prefectures. More accurate data is required to estimate this measure precisely.
There are several reasons why Hokkaido became such a concentrated production center of potatoes. Based on Kanayama's classification of profitability, the researcher attempt to explain these reasons as a basis of the assumption for the analysis of this situation.

Firstly, an important internal reason is the immobility of resources, namely, farm lands in Hokkaido. Figure 2.5 shows the number of farm households by the size of cultivated land in Hokkaido and other prefectures. The Ministry of Agriculture, Forestry and Fisheries of Japan (M.A.F.F.) applies different categories between Hokkaido and all other prefectures because they possess very distant conditions. The mode of farm land size in Hokkaido is 10.0-15.0 ha compared with 0.5-1.0 ha in all other prefectures. The average size of farm is 12.68 ha in Hokkaido and 1.05 ha for all others.\(^1\)

The yield of potatoes is shown in Table 2.4. The statistics reveal that Hokkaido has an yield nearly twice of other prefectures.

When we look at the level of technology employed in potato cultivation, Hokkaido reveals a unique historical background. One of the largest shipping co-operatives in Hokkaido is JA Shihoro (Shihoro Nokyo). According to Tachibana (1984), Shihoro Nokyo was the richest agricultural co-operative, attaining this position by enlargement of scale and capitalization. In 1980, the annual production of potatoes was 90,000 t, with half of the production sent to

\(^1\) (Source: "The Census", M.A.F.F., 1990) The number includes both commercial farm households and noncommercial farm households.
Figure 2.5: Number of Farm Households by Size of Cultivated Land (1994)

A: Prefectures excluding Hokkaido

B: Hokkaido

(Source: The 71st Statistical Yearbook, M.A.F.F., 1994-95)
an automated starch factory—the largest in Asia at that time—owned by the co-operative. The co-operative also owned a potato chip factory with a 60 t daily production and a fries factory with a daily production of 70 t. In addition, Shiho Nokyo owned an isotope facility to differ germination time of potatoes and a low temperature storage facility both in Shiho and in Kanagawa: a neighboring prefecture of Tokyo, which is the largest area of consumption. The co-operative also owned oil tanks which store 7,000 t of oil for local household, farming and industrial use in the area.

Table 2.4: Yields of Potatoes (1994-95)

<table>
<thead>
<tr>
<th>Area</th>
<th>Harvest(t)</th>
<th>Shipment(t)</th>
<th>Market Share</th>
<th>Yield(t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>108,200</td>
<td>3,377,000</td>
<td>2,663,000</td>
<td>1</td>
</tr>
<tr>
<td>Hokkaido</td>
<td>67,200</td>
<td>2,579,000</td>
<td>2,285,000</td>
<td>0.8581</td>
</tr>
<tr>
<td>Prefectures excluding Hokkaido</td>
<td>41,000</td>
<td>797,600</td>
<td>377,900</td>
<td>0.1419</td>
</tr>
</tbody>
</table>

(Source: The 71th Statistical Yearbook of Ministry of Agriculture Forestry and Fisheries, 1994-95)

In all, this co-operative invested 10 billion yen—equivalent to 62.5 million dollars at that time—in infrastructure for its potato production. Such a large scale facility is unknown in any other prefecture for any other vegetable production in Japan.

Tachibana also describes the historical background of the region. First of all, low land prices in Hokkaido exclusively allowed farmers to enlarge the scale of their farmlands. The comparative prices of farmlands in Hokkaido, suburban areas and the Japanese average are shown in Table 2.5.
Tachibana emphasizes another internal factor explaining Shihoro's dominance in potato production: the participation of the agricultural co-operative in the processing and marketing of its own agricultural production. Following Second World War, JA Shihoro purchased a starch farm—the first attempt by the potato producers to join the starch processing industry. The starch made by JA Shihoro eventually became a brand name in the fish processing industry. Tachibana posits the hypothesis that this was one reason why Shihoro and other production areas in Hokkaido became highly specialized in potato production, suggesting also that such strategies established the basis for the present day state of potato production in that area.

Table 2.5: Price of Farm Lands (Unit: yen/10a)

<table>
<thead>
<tr>
<th>Area</th>
<th>1960</th>
<th>1970</th>
<th>1980</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shihoro in Hokkaido</td>
<td>10,000</td>
<td>50,000</td>
<td>250,000</td>
</tr>
<tr>
<td>Average of Japan</td>
<td>130,000</td>
<td>910,000</td>
<td>3,200,000</td>
</tr>
<tr>
<td>Suburban areas</td>
<td>340,000</td>
<td>7,420,000</td>
<td>28,000,000</td>
</tr>
</tbody>
</table>

(Source: Nokyo, Tachibana, 1984, pp 25)

Table 2.6 shows the diversity of potato usage. In Shihoro's case, the production of starch potatoes initiated the growth of potato production as a whole, and it seems possible that the production of potatoes as a source of starch enhanced the large production of fresh potatoes for market trading. The high demand for potatoes as a source of starch necessary for the food processing industry can also be seen as an external factor in the formation of a large scale production center.
Table 2.6: The Usage of Potatoes in Japan (Unit: 1,000t)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Non-Commercial</th>
<th>Feed</th>
<th>Seed</th>
<th>Market</th>
<th>Material for Starch</th>
<th>Processed Food</th>
<th>Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>3,478</td>
<td>304</td>
<td>43</td>
<td>234</td>
<td>819</td>
<td>1,280</td>
<td>554</td>
<td>245</td>
</tr>
<tr>
<td>1991</td>
<td>3,550</td>
<td>302</td>
<td>39</td>
<td>218</td>
<td>793</td>
<td>1,322</td>
<td>624</td>
<td>253</td>
</tr>
<tr>
<td>1992</td>
<td>3,427</td>
<td>299</td>
<td>39</td>
<td>217</td>
<td>754</td>
<td>1,379</td>
<td>539</td>
<td>200</td>
</tr>
<tr>
<td>1993</td>
<td>3,325</td>
<td>265</td>
<td>33</td>
<td>213</td>
<td>708</td>
<td>1,362</td>
<td>515</td>
<td>139</td>
</tr>
</tbody>
</table>

(Source: M.A.F.F., 1995)

Having seen the concentration of the Japanese vegetable market, the background of increasing competition and historical reasons as to why Hokkaido became dominant in potato production, it seems logical to treat the Japanese potato market as a typical imperfect market.

However, Kanayama (1994) explains the following point: the scale of shipment has been enlarged in quantity. As far as each prefecture is regarded as a producer, the markets of several kinds of vegetables have monopolistic or oligopolistic structures. For example, Hokkaido, as a prefecture, has tremendous share in the potato market. Nevertheless, considering each farm household, the structure is that of conventional perfect markets in which there are numbers of price takers which produce comparatively small amounts compared to the whole market. This means that the imperfect structure of the vegetable market is at variance with cases in other industries, where each producer is an independent company with its own sole account. To analyze the supply side of the vegetable markets, it is not advisable to directly apply a conventional imperfect market theory.
In this research, however, the focus is on the degree of competition not among agricultural households as producers but among prefectures as units of shipment in the market. In other words, annual supply is taken as given and the focus of this analysis is on strategic disposition of the crop by the prefectoral organizations. Indeed, it may be reasonable to suppose a prefecture as the most practical units to define production areas considering legislative implements and strategy formation in vegetable production and marketing. These backgrounds are explained in the following sections, 2.5 and 2.6.

2.5 Marketing

In M.A.F.F. statistics, shipment of potatoes is counted by prefecture. In this research, the degree of competition is investigated according to these statistics by calculating the conjectural variation. This section describes the shipment organizations for vegetables in Japan in order to see precisely how the expectation in shipment is formed.

2.5.1 Classification

Shipments of potatoes can be classified as follows: 1. private shipment by producers; 2. shipment through shipping organizations formed by producers, such as agricultural co-operatives; 3. shipment by trading companies or private brokers; and 4. shipment through markets in production areas.
Figure 2.6: The Flow of Shipment

![Flow of Shipment Diagram](image)

(Source: The Structure and Role of Vegetable Shipping Organizations, Keino 1993, pp25)

Figure 2.6 shows the flow of products from producers to wholesale markets through each system. Table 2.7 shows the share of each form of shipment in the Japanese vegetable market.

In Table 2.7, the bold characters show the largest share amongst these forms of shipment. The most dominant form of shipment is the second one, shipment through organizations formed by producers, especially useful for the less perishable vegetables such as onions and potatoes. The share of shipping organizations in all shipments—and so the comparative importance of this type—is increasing (Keino, 1993). Figure 2.7 shows the change of the share of shipping organizations from 1968 to 1980.

Co-shipment by organizations means that the shipment includes at least one of the following: 1. co-transportation; 2. co-selection and co-grading; 3. co-accounting. These kinds of co-shipments are encouraged by legislation since
they result in improved efficiency in forming large scale production centers and also facilitate in the trading of large quantities with stable supply and standards.

These shipping organizations consist of: 1. comprehensive agricultural co-operatives (*Sogo-Nokyo*); 2. specified agricultural co-operatives (*Senmon-Nokyo*); 3. voluntary organizations by producers. In 1991, the shipment by comprehensive agricultural co-operatives, specified agricultural co-operatives and voluntary organizations were respectively 3,151 t, 40 t and 1,760 t (63.6%, 0.01% and 35.5% of the total). The system and function of these co-operatives is explained in the next section.

Private companies are local brokers who purchase and ship products from producers in production areas. Due to increasing competition, there is a tendency for the number of these brokers to decrease while the shipment by each company increases. Some of these private traders are excluded both by shipping organizations and the influence of increased co-shipments. However, these traditional brokers seem to be able to maintain their particular function in their own local production areas.

Collective markets in production areas are decreasing drastically: the number of markets for vegetables throughout Japan was 130 in 1968 and only 41 in 1991. (Keino, 1993)

---

1 Private broker's roles in each production area are, for example, trading by cash, purchasing products at farm gate and introducing experimental products in trading. Traditionally known as "Nage-Shi", a person who "throws" products, they long held a particular position in the marketing in those agricultural areas.
Table 2.7: The Share of Shipping forms in the Japanese Vegetable Market (1980) (Unit:%)

<table>
<thead>
<tr>
<th></th>
<th>Shipping organizations (a)</th>
<th>Co-shipment included in (a)</th>
<th>Markets in production areas</th>
<th>Trading Companies</th>
<th>Private Shipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomatoes</td>
<td>72.6</td>
<td>71.6</td>
<td>0.6</td>
<td>0.6</td>
<td>25.5</td>
</tr>
<tr>
<td>Lettuces</td>
<td>69.4</td>
<td>68.2</td>
<td>1.6</td>
<td>10.5</td>
<td>18.5</td>
</tr>
<tr>
<td>Sweet peppers</td>
<td>68.5</td>
<td>67.8</td>
<td>0.3</td>
<td>3.7</td>
<td>27.5</td>
</tr>
<tr>
<td>Onions</td>
<td>58.8</td>
<td>58.5</td>
<td>0</td>
<td>28.7</td>
<td>12.5</td>
</tr>
<tr>
<td>Cucumbers</td>
<td>55.1</td>
<td>53.7</td>
<td>2.1</td>
<td>2.2</td>
<td>40.7</td>
</tr>
<tr>
<td>Potatoes</td>
<td>50.8</td>
<td>50.3</td>
<td>0.2</td>
<td>24.7</td>
<td>24.2</td>
</tr>
<tr>
<td>Cabbages</td>
<td>47.5</td>
<td>45.4</td>
<td>1.3</td>
<td>12.7</td>
<td>38.6</td>
</tr>
<tr>
<td>Carrots</td>
<td>45.5</td>
<td>43.7</td>
<td>2.3</td>
<td>16.7</td>
<td>35.5</td>
</tr>
<tr>
<td>Eggplants</td>
<td>42.3</td>
<td>40.7</td>
<td>2.4</td>
<td>1.9</td>
<td>53.4</td>
</tr>
<tr>
<td>Chinese cabbages</td>
<td>41.4</td>
<td>36.8</td>
<td>4.2</td>
<td>15.8</td>
<td>38.6</td>
</tr>
<tr>
<td>Japanese radishes</td>
<td>31.2</td>
<td>29.8</td>
<td>1.2</td>
<td>6.9</td>
<td>60.8</td>
</tr>
<tr>
<td>Welsh onions</td>
<td>27.7</td>
<td>25.3</td>
<td>8.9</td>
<td>4.1</td>
<td>59.3</td>
</tr>
<tr>
<td>Taros</td>
<td>25.3</td>
<td>24.5</td>
<td>0.8</td>
<td>17.1</td>
<td>56.8</td>
</tr>
<tr>
<td>Spinach</td>
<td>24.8</td>
<td>22.7</td>
<td>4.6</td>
<td>3.5</td>
<td>67.1</td>
</tr>
</tbody>
</table>


Figure 2.7: The Share of Shipping Organizations for Vegetables (Total)

(Source: Keino, 1993)
Private shipment—individual producers shipping their products independently—
exhibit a similar reducing trend, though it still maintains an important position,
especially in production areas close to large cities.

Table 2.8: Destination of products from each shippers (1985)

<table>
<thead>
<tr>
<th>Destination / A: Wholesale Markets, B: Retail Stores, C: Others</th>
<th>Shipping organizations</th>
<th>Traders</th>
<th>Collective markets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A  B  C</td>
<td>A  B  C</td>
<td>A  B  C</td>
</tr>
<tr>
<td>Japanese Radishes</td>
<td>707 76 23 86 58 10 32</td>
<td>29 66 5 29</td>
<td></td>
</tr>
<tr>
<td>Chinese Cabbages</td>
<td>540 97 2 152 89 7 2</td>
<td>70 93 2 5</td>
<td></td>
</tr>
<tr>
<td>Cabbages</td>
<td>768 98 1 162 90 6 3</td>
<td>51 45 3 52</td>
<td></td>
</tr>
<tr>
<td>Onions</td>
<td>556 93 1 3 308 72 6 22</td>
<td>1 33 50 17</td>
<td></td>
</tr>
<tr>
<td>Carrots</td>
<td>289 96 1 4 113 84 4 12</td>
<td>8 86 11 4</td>
<td></td>
</tr>
<tr>
<td>Tomatoes</td>
<td>472 74 0 2 7 79 18 3</td>
<td>5 72 12 16</td>
<td></td>
</tr>
<tr>
<td>Cucumbers</td>
<td>526 94 0 5 21 78 11 10</td>
<td>14 40 7 52</td>
<td></td>
</tr>
<tr>
<td>Eggplants</td>
<td>214 98 0 2 8 87 11 2</td>
<td>10 63 4 33</td>
<td></td>
</tr>
<tr>
<td>Welsh Onions</td>
<td>145 95 2 3 14 77 19 4</td>
<td>31 91 9 0</td>
<td></td>
</tr>
<tr>
<td>Sweet Peppers</td>
<td>112 99 0 1 5 89 9 2</td>
<td>1 50 33 17</td>
<td></td>
</tr>
<tr>
<td>Taros</td>
<td>60 95 1 4 73 77 5 18</td>
<td>2 86 13 0</td>
<td></td>
</tr>
<tr>
<td>Spinaches</td>
<td>97 94 1 4 10 73 17 9</td>
<td>15 89 11 0</td>
<td></td>
</tr>
<tr>
<td>Lettuces</td>
<td>335 99 0 1 42 87 11 1</td>
<td>13 97 2 1</td>
<td></td>
</tr>
<tr>
<td>Potatoes</td>
<td>723 63 14 22 274 75 6 20</td>
<td>2 58 16 26</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5,544 88 2 10 1,275 77 7 16</td>
<td>252 75 7 18</td>
<td></td>
</tr>
</tbody>
</table>


The destinations of products from each kind of shippers are shown in
Table 2.8. Most destinations through shipping organizations are to wholesale
markets. The share of shipment to wholesale markets is 88% in this category,
with more than 90% for most products except potatoes, Japanese radishes and
tomatoes. Through brokers and collective markets, most products are designated to wholesale markets; “others” are mostly for processed vegetables.

2.5.2 Agricultural Co-operatives

As we saw in the previous section, shipping organizations own the dominant share of shipments in Japan. In both legislative and structural terms, the core of these organizations for a wide range of products is characterized by comprehensive agricultural co-operatives. In order to verify the assumption that each prefecture is regarded as a producer, the system and function of agricultural co-operatives and their business practice is investigated.

By the end of 1995, there were 2,446 agricultural co-operatives in Japan. These agricultural co-operatives are usually called Nokyo, an abbreviated form of Nogyo-Kyodo-Kumiai. Since 1992, these co-operatives have been called “JA”—the initials of Japan Agricultural Co-operatives—in an attempt to improve their co-operative image.

According to the Agricultural Co-operative Act (Nogyo-Kyodo-Kumiai-Ho), these co-operatives can participate in various kinds of activities such as: 1. the improvement of education, life and culture designed to enhance productivity in agricultural areas; 2. the management of projects concerning agricultural production; 3. the subcontracting of agricultural management and production; 4. the trust of farm lands; 5. the marketing of agricultural products; 6. the supply of materials for agricultural production and life in agricultural areas; 7. the financing

---

1 Concerning potatoes, a large part of shipment through shipping organizations is for material for processed food. In this thesis, potatoes traded through wholesale market will be analyzed empirically.
with respect to agricultural household; 8. the co-insurance concerning residents in agricultural areas; 9. the management of agricultural production and facilities; 10. food processing; 11. the social welfare such as ownership of hospitals; 12. The social welfare of senior citizens; and 13. the trust of residential lands transferred from agricultural farm lands.

When a co-operative concerns itself with all kinds of agricultural households in an area, it is called a comprehensive co-operative (Sogo-Nokyo). When it is aimed at particular farmers growing certain kinds of product, it is called a specific co-operative (Senmon-Nokyo).

In this thesis, the focus is on their economic activity, especially marketing of agricultural products—Activity No. 5, mentioned above.

Each agricultural co-operative in Japan is an independent organization both financially and legally; however, these co-operatives are members of larger organizations called “Rengo-Kai,” which are coordinated according to the field of their activities. Each organization has prefectural and national divisions. For economic activities, there are organizations called “Keizai-Nokyo-Rengo-Kai,”—Economic Organizations—more commonly known as “Keizai-Ren.” The national organization of Keizai-Ren is called “Zenkoku-Nokyo-Rengo-Kai,” or “Zen-No.” (Hijikata, 1996) Figure 2.8 shows the organization of this economic division of Japan Agricultural Co-operatives.

Individual co-operatives are basically independent and organize their own shipment mostly by co-shipment; however, each prefectural organization is connected to each single co-operative and the national organization with respect
to both software and hardware. The information of wholesale market is sent to these prefectural organizations and then to single co-operatives throughout the network. Hence, the prefectural organizations can offer some suggestions to

**Figure 2.8: The Organization of Economic Division of JA**

![Diagram of the organization structure of JA's Economic Division]

those responsible for shipment in each individual co-operative. We might reasonably suppose a certain degree of consensus amongst agricultural co-operatives in terms of shipment at the prefectural level.

An example of such co-operation at the prefectural level can be found in Kagoshima, where the prefecture government initiated a project for establishing brand names. The objective of this project was to establish a brand image with
authorization by the prefecture and hence increase the market value of the product from a certain area within the prefecture. In order to receive brand name authorization, the production areas must meet several conditions. These include: 1. the amount of co-shipment must be at least 500 million Japanese yen (5 million US dollars); 2. production and shipment planning must be established by negotiation between the area and prefectural shipment organizations—Ken-Keizai-Ren—in order to stabilize daily shipments; 3. the quality and standard of products must meet those of prefectural criteria; 4. the share of co-shipment must be more than 70%. These conditions, especially condition 2, 3 and 4, demonstrate that the particular project presupposes the consensus of agricultural co-operatives at the prefectural level.

According to this project, two agricultural co-operatives—JA Tokunoshima and JA Amagi—and other legislative bodies such as three specific

Table 2.9: Shipment from Two JA to Main Wholesale Markets (1994)

<table>
<thead>
<tr>
<th></th>
<th>Tokunoshima</th>
<th>Amagi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (ha)</td>
<td>334</td>
<td>90</td>
</tr>
<tr>
<td>Shipment (t)</td>
<td>3,418</td>
<td>932</td>
</tr>
<tr>
<td>Shipment for main wholesale markets (t)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melka</td>
<td>374</td>
<td>-</td>
</tr>
<tr>
<td>Meisei</td>
<td>-</td>
<td>153</td>
</tr>
<tr>
<td>Marukyo</td>
<td>278</td>
<td>-</td>
</tr>
<tr>
<td>Gifumaruka</td>
<td>-</td>
<td>102</td>
</tr>
<tr>
<td>Gika</td>
<td>209</td>
<td>-</td>
</tr>
<tr>
<td>Maruichi</td>
<td>217</td>
<td>155</td>
</tr>
<tr>
<td>Hamamatsu</td>
<td>-</td>
<td>76</td>
</tr>
</tbody>
</table>

(Source: JA Tokunoshima and JA Amagi¹, 1994)

¹ These figures were accumulated from bills in these two co-operatives.
town governments formed the “Tokunoshima Potato Brand Name Committee” to work on attaining these conditions and receive brand name authorization. Table 2.9 shows the shipment from these co-operatives in 1994. From the table, it can be seen that these co-operatives usually ship to different wholesale markets.

For example, Meika and Meisei, Gika and Gifu Maruka are different wholesalers or wholesale markets in the same area. Maruich in Tokyo is the largest wholesaler in Japan. While the total shipments of JA Tokunoshima is much greater than that of JA Amagi, JA Amagi sends a larger share of its shipment to this wholesaler. In this case, both co-operatives are located on the same remote island and foster a close relationship. Indeed, this is far from being an exceptional case in Japan. Generally, such co-operation amongst agricultural co-operatives is formed at the prefectural level with participation of *Keizai-Ren* and the prefectural government.

2.6 The Designated Vegetable Producing Area System and Wholesale Market System

This section will describe the factors affecting the production and marketing of vegetables, providing the fundamental assumptions—mobility of vegetables throughout Japan—for the construction of the estimation models of this research.
2.6.1 The Designated Vegetable Producing Area System

The assumption of monopolistic or oligopolistic powers of large production centers in the Japanese vegetable market presupposes that these products are traded and moved freely throughout Japan. As a whole, this assumption seems valid, though some examination of the Japanese vegetable market is required to ascertain whether this assumption does indeed hold true.

This section is a review of the Designated Vegetable Producing Area System (Yasai Shitei Sanchi Seido), which contributed to the emergence of large scale production centers of certain kinds of vegetables as a complement to the development of a Japanese central wholesale market system. The Designated Vegetable Producing Area System aimed at increasing the efficiency by way of software of domestic trading. On the other hand, the organization of wholesale markets was intended to implement and improve hardware for the Japanese vegetable trade.

The Designated Vegetable Producing Area System provides the basis of the assumption not only of mobility of vegetable products but also of prefectures as producers since, through this system, the large scale production centers have been formed through competitions among prefectures.

The Designated Vegetable Producing Area System (Yasai Shitei Sanchi Seido) was established under the Vegetable Production and Shipment Stabilization Act (Yasai Seisan Shukka Anteiho), which took effect in 1966. The aim of the act was "to stabilize production and shipment in designated production and consuming areas." (Chapter 1 of the Act).
This act specifies the designated vegetables which have been expected to have high demand, the designated consuming areas which are highly populated cities and the designated production areas for specified vegetables. In the designated production areas, producers have restrictions on the variety of their products and the destination of their shipment. The requirements for these production areas are that: 1. the area is shipping more than 2/3 of its total shipment through

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Total Shipment(A)</th>
<th>Shipment from the D.P.A.(B)</th>
<th>Shipment from D.P.A. to D.C.A.</th>
<th>(B)/(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabbages</td>
<td>1,326,000</td>
<td>777,000</td>
<td>751,000</td>
<td>58.60%</td>
</tr>
<tr>
<td>Cucumbers</td>
<td>734,700</td>
<td>406,600</td>
<td>380,500</td>
<td>55.34%</td>
</tr>
<tr>
<td>Taros/fall, winter</td>
<td>193,000</td>
<td>48,000</td>
<td>40,600</td>
<td>24.87%</td>
</tr>
<tr>
<td>Japanese radishes</td>
<td>1,722,000</td>
<td>475,900</td>
<td>458,200</td>
<td>27.64%</td>
</tr>
<tr>
<td>Onions</td>
<td>1,126,000</td>
<td>905,500</td>
<td>882,000</td>
<td>80.42%</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>641,300</td>
<td>277,400</td>
<td>260,900</td>
<td>43.26%</td>
</tr>
<tr>
<td>Eggplants</td>
<td>356,600</td>
<td>164,300</td>
<td>150,400</td>
<td>46.07%</td>
</tr>
<tr>
<td>Carrots</td>
<td>570,300</td>
<td>344,900</td>
<td>332,000</td>
<td>60.48%</td>
</tr>
<tr>
<td>Welsh onions</td>
<td>382,300</td>
<td>86,400</td>
<td>82,100</td>
<td>22.60%</td>
</tr>
<tr>
<td>Chinese cabbages</td>
<td>844,400</td>
<td>484,700</td>
<td>464,200</td>
<td>57.40%</td>
</tr>
<tr>
<td>Potatoes</td>
<td>2,804,000</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sweet peppers</td>
<td>130,300</td>
<td>81,700</td>
<td>77,500</td>
<td>62.70%</td>
</tr>
<tr>
<td>Spinaches</td>
<td>275,600</td>
<td>69,400</td>
<td>65,000</td>
<td>25.18%</td>
</tr>
<tr>
<td>Lettuces</td>
<td>479,000</td>
<td>371,400</td>
<td>362,600</td>
<td>77.54%</td>
</tr>
<tr>
<td>Total</td>
<td>11,585,000</td>
<td>4,793,200</td>
<td>4,307,000</td>
<td>38.8%</td>
</tr>
</tbody>
</table>

(Source: Statistics on Production and Shipment, M.A.F.F., 1991)

coshipping organizations such as agricultural co-operatives; 2. the area is sending more than 1/2 of its total shipment to the designated consuming areas; 3. in the area, the designated vegetable is produced in a certain amount of
area. When a production area is authorized as a designated production area, it can be granted various kinds of loans and subsidies from the government for better production and shipment facilities. Table 2.10 shows the shipment of the designated vegetables.

In 1991, the number of designated production areas was 1,187; the area for the designated vegetables were 1,250,000 ha; and the total shipment from D.P.A. was 38.8% of total shipment of the designated vegetables. Hotta (1995) explains that this system led to improvements in both efficient domestic trading between large producing areas and cities and in shipments.

Apparently, this system encouraged trade in vegetable products throughout Japan, which is the presumption of the hypothesis of this thesis.

2.6.2 Wholesale Market System of Japan

The assumption of monopolistic or oligopolistic powers of large production centers in the Japanese vegetable market presupposes that these products are traded and moved freely throughout Japan. As a whole, this assumption seems valid, though some examination of the Japanese wholesale markets is required to ascertain whether this assumption does indeed hold true.

In order to explore the mobility of fresh vegetable trade in Japan which led to the formation of large scale production, a brief historical overview of the legislative aspect of the Japanese wholesale market system must first be presented.

1 25 ha for root, leaf and stem vegetables, 15 ha for summer and fall fruit vegetables and 10 ha for winter and spring fruit vegetables.
During the pre-World War II period, wholesale markets existed in only nine cities throughout Japan. Under the influence of war, the government control of vegetable supply and distribution began in 1941, allowing only a short period for the establishment of free market trade. During World War II, the Japanese vegetable market operated under complete governmental control. Subsequently, in 1945, M.A.F.F. loosened governance of the market system by canceling most restrictions. Unfortunately, this quickly led to price inflation and hence governmental control was again imposed. Another four years passed before the government, in April 1949, could again relinquish market control. In order to avoid excessive concentration of economic power, the General Headquarters of the U.S. occupying military implemented a multiple middlemen system in each market; hence, the new wholesale market system involved hard competition since its earliest days.

By the beginning of the 1950s, Japanese food production recovered to the levels of the pre-war period and developed rapidly as a commercial agriculture. Since then, the core of the Japanese food supply, in terms of domestic trading, has been the central wholesale markets. With governmental control abolished, trade in the markets became freer. Alternately, negative side effects emerged due to severe competition among wholesale companies contesting in each central market. Responding to that trend, the government amended the Central Wholesale Market Law (*Chuo Oroshiuri Shijo Ho*) in 1956, 1958 and 1961. In these amendments, which included the licensing of wholesalers, governmental interventions were strengthened. Simultaneously, the government exempted
wholesale companies from antitrust laws and encouraged merging and reorganization of those wholesalers.

Throughout the 1950s, the Japanese economy became more active and inflating consumer prices drew government attention. At that time, the government considered domestic trading of food as a primary issue, with increased efficiency of wholesale markets as an immediate concern.

In the 1960s, Japan saw the beginning of rapid economic growth, and with that growth the circumstances of food trading changed drastically. Firstly, agricultural production areas developed from small to large scale production centers. Secondly, urban areas progressively became larger cities, absorbing the flood of population from rural areas and becoming large scale centers of consumption. The tendency then was for central wholesale markets in large cities to emerge as the leading centers of collection and distribution. Local markets also developed with these trends: by 1971, there were 3,321 local markets throughout Japan. The Vegetable Production and Shipment Stabilization Act (Yasai Seisan Shukka Anteiho) took effect in 1966 as an administrative selection of agricultural areas that encouraged the formulation of large scale production centers.

Responding to all these developments, the New Wholesale Market Law was enabled in 1966. The main contents of the law were:

1. Regulations and guidelines to plan the location and installation of central and local wholesale markets in order to organize market trade.
2. Technical improvements, such as trade by negotiation and buying by wholesalers, allowing the previously excluded large-scale buyers the opportunity to attend wholesale markets.

3. Regulation of local wholesale markets to enhance the efficiency of facilities and administration. This was the first legal attempt concerning local markets. The main focus of this law was to improve the efficiency of market trade in order that the trade system could meet the necessity of large scale trade. *(The Century of M.A.F.F., 1982)*

This overview then demonstrates that the Japanese government organized and implemented the wholesale market system after World War II to enhance the mobility and supply of agricultural products in Japan. In other words, the presumption of this study: mobility of vegetables throughout Japan, has been a long-term objective of the Japanese legislative body.

Table 2.11 shows shipment of potatoes for fresh consumption from main production prefectures to Designated Consuming Areas. The diagonal elements of the table shows the shipment from the main production prefectures in one agricultural region to large consuming areas in the same region. The percentage of the diagonal elements is 24% of all the shipment to the designated consuming areas, which occupies 95% of all fresh potato shipments. From these data, we can see that a large portion of fresh potato production is moved from region to region, mostly, of course, from the Hokkaido region.
Table 2.11: Fresh Potato Shipment from Main Production Prefectures to Designated Consuming Areas in 1992 (Unit: t)

<table>
<thead>
<tr>
<th>Production</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hokkaido</td>
<td>89,100</td>
<td>20,400</td>
<td>15,610</td>
<td>169,870</td>
<td>34,820</td>
<td>80,300</td>
<td>19,300</td>
<td>9,080</td>
<td>20,400</td>
</tr>
<tr>
<td>Tohoku</td>
<td>8,050</td>
<td>164</td>
<td>5,547</td>
<td>3,222</td>
<td>3,602</td>
<td>1,790</td>
<td>493</td>
<td>6,060</td>
<td></td>
</tr>
<tr>
<td>Hokuriku</td>
<td>-</td>
<td>3,840</td>
<td>616</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Kanto-Tosan</td>
<td>1,055</td>
<td>5,270</td>
<td>895</td>
<td>36,883</td>
<td>1,279</td>
<td>3,874</td>
<td>22</td>
<td>14</td>
<td>2,227</td>
</tr>
<tr>
<td>Tokai</td>
<td>-</td>
<td>-</td>
<td>46</td>
<td>8,227</td>
<td>9,564</td>
<td>2,383</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Kinki</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>708</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Chugoku</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>150</td>
<td>12</td>
<td>3,176</td>
<td>3,510</td>
<td>83</td>
<td>-</td>
</tr>
<tr>
<td>Kyushu</td>
<td>145</td>
<td>1,180</td>
<td>6,545</td>
<td>51,807</td>
<td>19,503</td>
<td>24,157</td>
<td>7,278</td>
<td>5,030</td>
<td>21,513</td>
</tr>
</tbody>
</table>

1. Total for Fresh=745,600; 2. Total for Designated Consuming Area=708,800

Sum of Diagonal Element=173,168 (=24% of Total for D.C.A.)


The Designated Vegetable Producing Area System, which decides the designated consuming areas, was described in the section 2.6.1 and revealed how the legislative body enhanced the mobility of vegetable trade.

2.6.3 Transfer among wholesale markets

In Japan, there is often a transfer of vegetable products among markets. The transfer of vegetables means that products once purchased and delivered in a certain wholesale market are resolved in another wholesale market.

The background of these transfers is, primarily, the concentrated shipment to central wholesale markets in large city areas. In simple terms, the economic power of these large urban areas with centralized wholesale markets results in concentrated purchasing of products. The products are then sent to other wholesale markets and local wholesale markets. This fact may affect the

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1 In M.A.F.F. statistics, the quantity of those products is referred as "transmitted quantity."
analysis of oligopolistic power of dominant production areas in Japanese markets. For this reason the investigation of the transfer of vegetables requires some attention.

Table 2.12 shows the transferred quantity of the most common vegetables. Among this quantity, some parts are purchased by a trader in one wholesale market and may be sold to another wholesale market as products of a prefecture different from their true origin. This quantity, however, is unavailable due to restrictions of data. In some cases, the true origin of these products may not be declared.

In respect of potatoes, the quantity transferred is 4.25% of all marketed products, the smallest among vegetables shown in the table. The markets studied in this thesis are representative of the central wholesale markets in each region of Japan. There may be small quantities of potatoes which are transferred from other markets to these markets, especially to Sapporo and Tokyo. Sapporo is the largest market in Hokkaido, the most dominant production area of potatoes; Tokyo is the most exceptionally concentrated city in the entire world. Most products are primarily shipped to the central wholesale market of Tokyo. Therefore it is reasonable to postulate that most potatoes available in the market come directly from large production areas to Tokyo. Hence, the quantity and price in this market shows the degree of competition of these areas with only a small disturbance caused by transfer. With regard to Fukuoka and Okinawa, the quantity of potatoes transferred from other markets is also unknown.
Although the transferred share in all potatoes is small, when we exclude the non-wholesale market, the transferred share is somewhat more significant. However, there is no way to ascertain the true origin of such products in the final wholesale market. In this research, regarding the four markets concerned, this factor is not considered in the analysis.

Table 2.12: Transferred Quantity of Vegetables (1995)

<table>
<thead>
<tr>
<th>Vegetables</th>
<th>Transmitted Quantity (A)</th>
<th>Total Marketing Quantity (B)</th>
<th>(A/B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japanese radishes</td>
<td>117,276</td>
<td>1,610,000</td>
<td>7.28%</td>
</tr>
<tr>
<td>Carrots</td>
<td>111,846</td>
<td>569,300</td>
<td>19.65%</td>
</tr>
<tr>
<td>Chinese cabbages</td>
<td>87,470</td>
<td>824,800</td>
<td>10.60%</td>
</tr>
<tr>
<td>Cabbages</td>
<td>128,044</td>
<td>1,279,000</td>
<td>10.01%</td>
</tr>
<tr>
<td>Spinach</td>
<td>16,143</td>
<td>292,200</td>
<td>5.52%</td>
</tr>
<tr>
<td>Welsh onions</td>
<td>27,753</td>
<td>399,200</td>
<td>6.95%</td>
</tr>
<tr>
<td>Lettuces</td>
<td>71,561</td>
<td>487,100</td>
<td>14.69%</td>
</tr>
<tr>
<td>Cucumbers</td>
<td>72,779</td>
<td>726,500</td>
<td>10.02%</td>
</tr>
<tr>
<td>Eggplants</td>
<td>42,275</td>
<td>364,800</td>
<td>11.59%</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>54,465</td>
<td>660,500</td>
<td>8.25%</td>
</tr>
<tr>
<td>Sweet peppers</td>
<td>22,352</td>
<td>140,100</td>
<td>15.95%</td>
</tr>
<tr>
<td>Potatoes</td>
<td>112,956</td>
<td>2,663,000</td>
<td>4.24%</td>
</tr>
<tr>
<td>Taros</td>
<td>14,105</td>
<td>136,800</td>
<td>10.31%</td>
</tr>
<tr>
<td>Onions</td>
<td>163,588</td>
<td>934,500</td>
<td>17.51%</td>
</tr>
</tbody>
</table>

2.6.4 Marketing of Vegetables Outside the Wholesale Market System

In this study, the degree of competition in the Japanese potato market will be measured according to the quantity traded in wholesale markets. However, there are some products dealt with outside the market system. To articulate the oligopolistic power of large production areas, the marketing of vegetables outside of market trade is investigated in this section. According to Yamamoto (1986), there are three main underlying reasons for the emergence of trading outside of the wholesale market system.

The first concerns the problem of vegetable prices. In the 1960s, the consumer price policy was a serious and particular concern of the government. However, the increase in the consumer price was 48.0% for vegetables, 27.0% for fruits, 111.0% for fresh sea foods and 41.8% for meat. Amongst these fresh foods, the seasonal fluctuation of vegetable prices was the focus of criticism. Even when the harvest was very abundant and producer prices low, consumer prices still tended to increase. In an efficient market system, the consumer price should be close to the addition of producer price and shipping and handling cost within the trading system. The situation during the 1960s was opposite to this principle; hence both producers' and consumers' faith in the market system was diminished. This sense of injustice developed into a movement which sought to abolish existing traders in the market process. This movement was formed as a direct trade between producers and consumers (San-Choku).

The second involved a change in the producers' attitude towards the marketing of their products. According to the enlargement of production areas,
explained in the previous sections, the scale of investment in production, shipping and handling grew correspondingly. The necessity for producers to predict prices increased as a result of a higher level of investment. As in other industries, larger producers tend to own not only the means of production but also of marketing rights, sharing both the cost of marketing and the benefit from marketing margins. These conditions encouraged shippers, such as agricultural co-operatives and other producers' organizations, to sell their products directly to ordinary consumers through their own stores as well as large scale retailers and consumers through direct contract. (Yamamoto, 1986)

The third and final impetus was the emergence of large size retailers\(^1\), such as supermarkets and the retailing divisions of agricultural co-operatives. The continued reduction in the number of small retailers means that the significance and necessity of the wholesale market system is similarly reduced: what was once cause and effect is now only effect. Without a large number of retailers as purchasers in wholesale markets, the function of a wholesale market itself does not have significance. The growth of the Japanese economy caused a change in general purchasing behavior. The gradual decrease in family size, the broader use of instant food and the availability of electricity resulted in a correlative reduction in the time required for household chores. Consequently, house-workers were now able to make purchases from larger areas, seeking better prices thus encouraging the development of large sized retailers. These new retailers had attempted to decrease the market margin by purchasing

\(^1\) Amongst these large scale retailers are, for example, Daiei and Ito-Yokado, which have established their branches abroad.
products directly from large producers, or by installing collection facilities in production areas, effectively functioning therefore as wholesalers in the place of the existing wholesale market system. Table 2.13 shows a chronic change in the share of retailers in the purchase of vegetables.

Table 2.13: Share of Retailers in Purchase of Vegetables (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>1964</th>
<th>1974</th>
<th>1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle size cities</td>
<td>Small size retailers</td>
<td>74.3</td>
<td>60</td>
</tr>
<tr>
<td>Supermarkets</td>
<td></td>
<td>11.3</td>
<td>31.6</td>
</tr>
<tr>
<td>Small cities(A)</td>
<td>Small size retailers</td>
<td>69.7</td>
<td>57.7</td>
</tr>
<tr>
<td>Supermarkets</td>
<td></td>
<td>12.1</td>
<td>32.5</td>
</tr>
<tr>
<td>Small cities(B)</td>
<td>Small size retailers</td>
<td>65.4</td>
<td>57.3</td>
</tr>
<tr>
<td>Supermarkets</td>
<td></td>
<td>9.7</td>
<td>30.2</td>
</tr>
<tr>
<td>Towns and villages</td>
<td>Small size retailers</td>
<td>69</td>
<td>62.4</td>
</tr>
<tr>
<td>Supermarkets</td>
<td></td>
<td>6.9</td>
<td>26.2</td>
</tr>
</tbody>
</table>

Middle size cities: population 15,000-100,000; Small cities(A): 50,000-150,000; (B): less than 50,000

(Source: National Survey of Consumption, Prime Minister's Office)

The tendency towards an increasing dependency upon large scale retailers is obvious. There is, however, no official survey taken on the quantity of vegetables traded outside of wholesale markets.

Concerning potatoes, figures for shipment quantities are shown in Table 2.14. The share of wholesale quantity is very small. In terms of potatoes, the share for processed material is very high, a factor which affects the low share of wholesale potato trading. These conditions will be discussed further in the next section.
Table 2.14: Shipment Quantity and Wholesale Quantity of Potatoes

<table>
<thead>
<tr>
<th>Shipment quantity (ton)</th>
<th>Quantity through market (ton)</th>
<th>Transferred quantity (ton)</th>
<th>Share of wholesale quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,663,000</td>
<td>947,108</td>
<td>112,956</td>
<td>31%</td>
</tr>
</tbody>
</table>

(Source: M.A.F.F., 1994)

2.7 Supply and Demand Analysis of the Japanese Potato Market

In this section, the supply and demand analysis of potatoes in Japan is provided in order to establish the basis of the empirical analysis. The emphasis is upon: 1. the statistical facts which demonstrate the importance of potatoes in the Japanese economy and vegetable market, the reasons potatoes are chosen as the subject of this thesis; 2. the concerns in the model construction of the estimation model.

2.7.1 Economic Importance and Location of the Potato Industry

The marketing quantity of potatoes is the largest of all vegetables produced in Japan, yielding 2,663 thousand tons in 1994, compared to 1,610 thousand tons for Japanese radishes, 1,279 thousand tons for cabbages and 935 thousand tons for onions. In wholesale quantity, potatoes have the fifth largest quantity: 947,108 t, superseded by cabbages, onions, Japanese radishes and Chinese cabbages. This quantity is 35.6% of the marketing volume. The monetary value of wholesale potatoes is 101,538 million yen—equivalent to 1.03 million U.S. dollars—the tenth highest of all vegetables.

1 Included in Statistics of Japan, Prime Minister’s Office, 1990
In 1994, the gross agricultural production of Japan was 104,472 hundred million yen. Potatoes and sweet potatoes\(^1\) had gross products of 2,467 hundred million Japanese yen, 2.36% of the gross agricultural total. In supplies per capita, 15.3 kg of potatoes were supplied per year with 69.2 kg of rice, 32.2 kg of wheat, 102.6 kg of vegetables, 29.9 kg of meat and 36.3 kg of fish and other sea foods.

Table 2.15: Food Balance Sheet (F.Y.1993)\(^1\) (Unit: 1,000t)

<table>
<thead>
<tr>
<th></th>
<th>Domestic production</th>
<th>Imports</th>
<th>Exports</th>
<th>Supplies for domestic consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>7,834</td>
<td>1,049</td>
<td>0</td>
<td>10,476</td>
</tr>
<tr>
<td>Potatoes</td>
<td>3,390</td>
<td>531</td>
<td>2</td>
<td>3,919</td>
</tr>
<tr>
<td>Vegetables</td>
<td>14,773</td>
<td>1,921</td>
<td>1</td>
<td>16,693</td>
</tr>
</tbody>
</table>

Table 2.15 is the Food Balance Sheet for the 1993 fiscal year, comparing potatoes, rice—the main cereal of Japan—and other vegetables.

Of the 3,390 thousand metric ton of potatoes produced in fiscal year 1993, about 54.22% were used for either fresh or processed food. Secondary outlets for potatoes total 34.75% for industrial use, mainly for starch and flour.

\(^1\) There is no separate statistics on gross national products of potatoes and sweet potatoes.
The third and fourth outlets were 5.59% for seed and 0.87% for feed. Finally, shrinkage, waste and loss made up about 4.6% of all production. These statistics display only slight variation from year to year.

The food self-sufficiency rate for potatoes and sweet potatoes was 100% until 1970, progressively decreasing to 91% in 1992. This figure, at 90%, is slightly higher than that of other vegetables and lower than that of rice, which is 101%.

400 thousand tons of potatoes were imported in 1989 and 529 thousand tons in 1993. This quantity has been slightly increasing. Up to 2 thousand tons of potatoes were exported between 1989 and 1993.

From these statistics, it became clear that potatoes have an important position in the Japanese agricultural economy.

The comparison of areas and production with other countries is shown in Table 2.16 revealing the scale of the Japanese potato industry.

Table 2.17 shows the planted area, harvest and shipment of potatoes by region. The most dominant agricultural region for potatoes is, as we have

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1 Food Balance Sheet (F.Y.1993), M.A.F.F. This table is estimated by the formula by FAO. The calculation period is one year from April 1 to March 31.
Table 2.16: Potato Planted Area and Production of the Main Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Area (1,000ha)</th>
<th>Production (1,000t)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>World Total</td>
<td>17,784</td>
<td>257,929</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>171</td>
<td>5,452</td>
<td>2.114%</td>
</tr>
<tr>
<td>Former East Germany</td>
<td>116</td>
<td>2,825</td>
<td>1.095%</td>
</tr>
<tr>
<td>Former West Germany</td>
<td>232</td>
<td>7,400</td>
<td>2.869%</td>
</tr>
<tr>
<td>Poland</td>
<td>1,733</td>
<td>29,038</td>
<td>11.258%</td>
</tr>
<tr>
<td>Britain</td>
<td>177</td>
<td>6,279</td>
<td>2.434%</td>
</tr>
<tr>
<td>Former Soviet Union</td>
<td>6,017</td>
<td>64,861</td>
<td>25.147%</td>
</tr>
<tr>
<td>U.S.</td>
<td>556</td>
<td>18,943</td>
<td>7.344%</td>
</tr>
<tr>
<td>China</td>
<td>3,002</td>
<td>31,036</td>
<td>12.033%</td>
</tr>
<tr>
<td>India</td>
<td>942</td>
<td>15,254</td>
<td>5.914%</td>
</tr>
<tr>
<td>Japan</td>
<td>120</td>
<td>3,609</td>
<td>1.399%</td>
</tr>
</tbody>
</table>

(Source: Production Yearbook 1992, FAO)

discussed, Hokkaido, the northernmost prefecture and region of Japan. Besides Hokkaido, Kyushu and Hokuriku also have large shares of production. As shown in Figure 2.1, they are located in the southern and central part of Japan respectively. In addition, Okinawa has 0.3% of all the potato production in Japan, placing it to 35th in all 47 prefectures. Okinawa, a prefecture formed of remote islands in the southernmost part of Japan, reveals the geographically widespread nature of potato production in Japan.

Potatoes in Japan are classified into two groups: spring and autumn, planted for different seasonal crops according to the usual times of planting. Various prefectures supply for different seasons, with some established as main production areas in both seasons. Principle potato producing areas by season are shown in Figure 2.9.

1 Hokkaido was developed much more recently and its area is comparatively larger than other regions in Japan. Accordingly, it is classified not only as a prefecture but a region in its own right.
Table 2.17: Potato Production by Region (1994-95)

<table>
<thead>
<tr>
<th>Region</th>
<th>Area (ha)</th>
<th>Harvest(t)</th>
<th>%</th>
<th>Shipment(t)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>108,160</td>
<td>3,379,580</td>
<td>100</td>
<td>2,663,039</td>
<td>100</td>
</tr>
<tr>
<td>Hokkaido</td>
<td>67,200</td>
<td>2,579,000</td>
<td>76.31</td>
<td>2,285,000</td>
<td>85.80</td>
</tr>
<tr>
<td>Tohoku</td>
<td>7,998</td>
<td>172,700</td>
<td>5.11</td>
<td>52,160</td>
<td>1.96</td>
</tr>
<tr>
<td>Hokuriku</td>
<td>10,052</td>
<td>225,210</td>
<td>6.66</td>
<td>98,034</td>
<td>3.68</td>
</tr>
<tr>
<td>Kanto-Tosan</td>
<td>2,272</td>
<td>43,160</td>
<td>1.28</td>
<td>8,548</td>
<td>0.32</td>
</tr>
<tr>
<td>Tokai</td>
<td>2,762</td>
<td>49,040</td>
<td>1.45</td>
<td>27,390</td>
<td>1.03</td>
</tr>
<tr>
<td>Kinki</td>
<td>1,800</td>
<td>22,220</td>
<td>0.66</td>
<td>5,747</td>
<td>0.22</td>
</tr>
<tr>
<td>Chugoku</td>
<td>2,502</td>
<td>39,960</td>
<td>1.18</td>
<td>10,680</td>
<td>0.40</td>
</tr>
<tr>
<td>Shikoku</td>
<td>1,553</td>
<td>23,500</td>
<td>0.70</td>
<td>8,590</td>
<td>0.32</td>
</tr>
<tr>
<td>Kyushu</td>
<td>11,690</td>
<td>217,990</td>
<td>6.45</td>
<td>164,080</td>
<td>6.16</td>
</tr>
<tr>
<td>Okinawa</td>
<td>331</td>
<td>6,820</td>
<td>0.30</td>
<td>2,810</td>
<td>0.11</td>
</tr>
</tbody>
</table>


Figure 2.9: Principal Potato Producing Areas by Season

(Spring Planted)  
(Autumn Planted)

(Source: Crop Statistics, M.A.F.F., 1993)
2.7.2 Major Economic Relationships

Figure 2.10, produced by the U. S. Department of Agriculture (U.S.D.A.) illustrates the major economic relationships applicable to the late summer and fall crops of potatoes in the United States. The primarily physical influences are represented by boxes, the primarily economic influences by circles. The solid lines with arrows connecting the various items indicate the more important factors; solid lines without arrows indicate interrelated physical quantities; and dotted lines denote the relationship between decision making and operation. Arrows show the principle direction of influence in each factor; double-pointed arrows connect variables believed to be simultaneously determined. The relative sizes of the boxes and circles do not indicate their relative importance.

According to U.S.D.A. (1967), sorting potatoes into different lots by grade and size results in the channeling of higher quality potatoes into food and the less preferred grade and size for livestock and starch use. Hence, as the diagram indicates, prices and consumption for food, livestock feed and starch are interrelated and factors affecting any one of these also indirectly affects others in the group.

Variables concerning the general economy, such as consumers' disposable income, prices and quantities of competing foods, as well as tastes and preferences, are independent of the potato economy. However, changes in these external variables affect changes in both prices and consumption of
Figure 2.10: Major Relationship in the Potato Economy

**Figure 2.10a: Production Sector**

- Previous level of acreage
- Weather
- Acreage
- Decision making
- Weather
- Previous level of yield
- Yield
- Harvested production
- Technological factors
- Unharvested production
- Price of potatoes (current and lagged)
- Price of potatoes (lagged)
- Technological factors

**Figure 2.10b: Market Sector**

- Imports
- Domestic supply
- Exports
- Domestic consumption
- Price of substitutes
- Consumption for food (lagged)
- Consumer income
- Tastes & preference
- Price of feeder steers
- Farm price of potatoes
- Government programs
- Marketing costs
- Retail price of potatoes

(Source: Demand and Price Analysis for Potatoes, U.S.D.A., 1967)
Based on the descriptive analysis in the previous sections of this paper, this general model may also stand for the Japanese potato market.

In this research, the market power of the dominant production areas and the possibility of collusion are studied with the focus on their decision making upon their shipment. In another words, the methodology used in this study will reduce the dynamic term of short run behavior of shipping entities into a static term represented by conjectural variations. It excludes analysis of longterm overall production. Accordingly, among two sectors in the figure, the market sector is mainly related to the focus of this study. Basically, the scope of the empirical model constructed for this study is the area which is surrounded by a broken line in Figure 2.10b. Through the wholesale market system, only potatoes for food are traded hence we do not consider price determination of potatoes for other usage in this study. The focus, therefore, is on short term prefectural decisions in the context of wholesale markets.

To keep the model manageable not all the data in the area discussed above appear in the empirical model. This stems from a lack of data and the exclusion of those factors with minor effects.

### 2.7.3 Substitutes and Variety of Potatoes

According to U.S.D.A.(1967), in the United States, frozen vegetables have a statistically significant substitution effect on the consumption of potatoes.

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1 These general ideas about economic relations in the potato industry are based on *Demand and Price Analysis for Potatoes*, Economic Research Service Technical Bulletin No.1380, U.S.D.A. 1967, pp10-12
However, Japanese dietary habits generally means that potatoes may be treated as a fresh vegetable for side dishes and not as a main source of carbohydrates. In terms of marketing quantity, as already mentioned, potatoes are the most consumed vegetable, followed by Japanese radishes, cabbages and onions. Amongst these, it is difficult to specify a particular product or particular products as a potato substitute. In Kanayama (1995), the researcher makes this point and constructs the demand function without explanatory variables for substitutes and compliments. Also, there are several kinds of potatoes in the Japanese potato market, with slightly different culinary uses and a different market value in each market.

Usually, when a market is handling comparatively large amount of potatoes and there is practically enough variation to differentiate between potato types, they include these variety categories in their statistics. For example, in the Sapporo market and the Tokyo market, potatoes are classified into "May Queen," "Danshaku" and "Other Potatoes." In the Fukuoka market, until 1992, potatoes were classified only as "Bareisho" and since then as "Bareisho" and "May Queen." In the Okinawa market, potatoes have been classified only as "Jaga Imo" even though there are several types of potatoes in the market as well as other markets.

Generally, "May Queen" is a white potato with an elongated shape and "Danshaku" a round potato—which is the most traditional variety in Japan. "Bareisho" and "Jaga Imo" are the most common names for categories which includes all kinds of potatoes. Within the "Danshaku" variety, there are more
precise classifications, such as "Dejima" and "Norin #2," stemming from singular factors such as biological classification and origin of the seeds. Those minor classifications, however, are usually not involved in actual trading. "Other Potatoes" include some other kinds such as reddish potatoes and yellowish potatoes.

In production areas, the decisions as to the kinds of potatoes to be produced are based on both the physical conditions—such as vulnerability to disease—and on market value. However, in many cases, the former conditions have greater priority since there is no significant difference amongst prices and treatments of those kinds of potatoes.

Because of the conditions mentioned above and to treat all four markets in the same manner, the total quantity of potatoes is considered without differentiating between kinds of potatoes. Hence the price of potatoes is treated as the average price throughout the following analysis.

### 2.7.4 Graphical Overview of the Japanese Potato Markets

Before constructing estimation models, a graphical overview of the Japanese potato markets is presented to clarify the price behavior. Figure 2.11 shows production of potatoes from 1926 to 1994. Figure 2.12 shows shipment of potatoes from 1965 to 1994.

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1. These conditions, especially regarding production areas, are based on the researchers investigation and interviews in wholesale markets and production areas.
2. In Kanayama (1995) and in most statistics by M.A.F.F., those potatoes are treated as one kind of product.
Figure 2.11: Production of Potatoes 1926-1994

Production of Potatoes 1926-1994

Figure 2.12: Shipment of Potatoes 1926-1994

Shipment of Potatoes 1965-1994
The total production of potatoes followed a constant upward trend until 1986 and since then a downtrend. Correspondingly, shipments of potatoes show a similar tendency, also following a downtrend since 1986.

Figure 2.13 shows the monthly marketing quantities in the four wholesale markets from 1986 to 1995. They clearly reveal the seasonal fluctuations in all markets; however, the seasonal pattern—such as a peak month and a bottom month—varies from market to market.

According to this preview, the demand function will be constructed individually for the four markets. To adjust the seasonality in data is also required. The estimation model to construct the demand functions and results will be presented in Chapter Four and Chapter Five.
Figure 2.13: Monthly Market Quantity in the Four Markets

A: Sapporo Market Quantity

B: Tokyo Market Quantity

C: Fukuoka Market Quantity

D: Okinawa Market Quantity

This chapter provides a review of the literature used in this thesis. The various studies outlined provide a framework for the evaluation of the degree of market competition and also presented examples of empirical analysis concerning imperfect markets, especially using conjectural variations.

Iwata (1974) provides the framework for the analysis of numerical values of conjectural variations. Based on the Japanese flat glass industry, this study established the theory and methodology for the statistical estimation of conjectural variations. The study also provides two statistical tests. The first, a test for the hypothesis that the conjectural variation is equal to a certain value; the second, a test for the hypothesis that the conjectural variations satisfy the conditions for the contract curve—the set of output equilibrium under collusion among producers. Iwata's analysis is rather experimental; however, it provides the framework and assumptions to construct an estimation model and the method to evaluate the subject clearly.

There are several works which present the conjectural variations analysis that examine the level of market competition in a purely theoretical manner.

Kamien and Shwartz (1983) discusses several fundamental topics concerning conjectural variation analysis. Firstly, the study explains that a harmonic sum of conjectural variations in a homogeneous market contains comprehensive information regarding market structure and conduct—the
producer’s beliefs of co-ordination. Subsequently, the role of similarity of beliefs in market performance and inconsistency of conjectural variations is examined. The latter point has been discussed in later research as a limitation of conjectural variations analysis—reducing dynamic term into momentary expression. Finally, the study discusses the relationship between conjectural variations in prices and conjectural variations in quantities that are equivalent in terms of outcome. Conjectural variations in quantities represent the robust models of oligopoly in interpretation more simply than in prices, hence, conjectural variations in quantities are employed in this thesis.

Dixit (1986) also explains general concepts of conjectural variations analysis. Dixit refers to two particular merits of conjectural variations analysis in the comparative statics for oligopoly as follows:

"First, by specifying the conjectures appropriately, we can include many different and familiar models in the same formal framework. These include Cournot, Bertrand, and the case with consistent or rational conjectures. Second, the conjectural variations, treated as parameters, allow us to capture the idea of varying degrees of competition." (p. 107)

Both of these reveal the most significant reasons why conjectural variation analysis is employed in this thesis. Dixit then presents theories on two cases: duopoly, with largely general demand functions; and homogeneous-product oligopoly. Conjectural variations analysis on oligopoly with general forms of
product heterogeneity was not discussed since it did not present useful general results.

There are various applications of conjectural variations analysis in general industry cases.

Geroski, et al. (1985), reviews literature on oligopoly, focusing on imperfect information, the empirical analysis of pricing behavior and non-price strategic competition. The historical development of studies on testing price-taking behavior, estimating conjectural variations and varying conduct models are also examined. For the tests for price-taking behavior, studies on cases with heterogeneous industry outputs are mainly presented. Conjectural variation analysis is discussed as a way to parameterize various oligopoly solution concepts. Geroski highlights the main difficulty of a conjectural variations analysis—interpretation of the numbers estimated differed from those corresponding to the familiar solution concepts of oligopoly theory—suggesting the usefulness of estimating conjectures subject to the constraint that the estimates were interpretable in the light of familiar oligopoly models. The paper then examines non-price strategic competition, such as product differentiation and the localization of competition.

Appelbaum (1982) studies the U.S. rubber, textile, electrical machinery and tobacco industries presenting application of conjectural variations analysis to various industries. In this paper, conjectural elasticity is also introduced. A distinctive part of Appelbaum’s paper is a presentation of the measure of oligopoly power as a weighted sum of the squared shares of firms in the industry,
multiplied by the inverse demand elasticity. The weights are given by the conjectural variations. This measure is known as the Lerner Index. Appelbaum assumes equal market shares for all firms, then estimates equilibrium conjectural elasticity for the four industries. Hence, this method is not directly applicable to the question of the Japanese vegetable markets. Additionally, this paper does not present the statistical test that those conjectural elasticities were identical to a certain value, specifying a certain model of oligopoly in the markets. The result shows that the rubber and textile industries were competitive and the electrical machinery and tobacco industry were more imperfectly competitive.

Gollop and Roberts (1979) test size specific Cournot hypothesis and equality hypothesis. The econometric model developed is based on the necessary conditions for producer equilibrium, which includes the firm's conjectural variation. The coffee roasting industry provides the subject for the analysis. The model is used to test whether all or some particular subset of firms behave independently. As a result, this Cournot behavior was rejected. With the result obtained, interdependent behavior is tested through homogeneity restrictions within the industry. The possibility of interdependent behavior could not be rejected. The topic is developed in Roberts (1984) using parametric tests for the various solutions of oligopoly.

Roberts (1984) develops an empirical model of short-run pricing behavior for firms in the coffee roasting industry as an example of a homogeneous product oligopoly. Regarding estimated conjectural variations, this particular paper provides a parametric test for price-taking, dominant firm and Cournot
behavior. The hypothesis of dominant firm behavior and Cournot behavior are rejected, while the hypothesis of price-taking behavior is not rejected with the exception of the largest two firms. The dominant firm model proposed is one where a single profit-maximizing firm operates in an industry with a fringe group of competitive suppliers. The dominant firm, in deciding its output level, takes into account its impact on both market price and the quantity of output of the fringe group. The dominant firm model can be employed in the Japanese vegetable markets if the behavior of leading producers is considered imperfectly competitive.

There are also other methods to evaluate the level of competition in a market.

Sumner (1981) proposes a scheme to measure monopoly pricing behavior in the cigarette industry. The goal was to identify the ratio of price to marginal cost. The method, using the coefficient of the tax-rate term in a price equation, required data on product price and some factor to provide unit cost such as excise tax. This scheme examines the existence of monopoly by the interregional comparison of prices and costs. This method is useful for industries where reliable cost data are not available.

Using excise tax as a proxy of marginal cost, Sullivan (1985) also investigates the level of competition in the cigarette industry, using data on the effects of excise taxes from 1955 to 1982. The comparative statics of the conjectural variations model shows that certain responses of price and output to variations in the tax rate can indicate the particular level of competition.
There are also various applications of conjectural variations analysis in agriculture.

Holloway (1991) revises comparative statics of eight food industries—beef and veal, pork, poultry, eggs, dairy, processed fruits and vegetables, fresh fruit and vegetables—under the hypothesis of perfect competition done by Gardner in 1975. Providing a conceptual framework for the analysis of imperfect competition by conjectural variations, the models were extended to those under oligopoly with endogeneous entry. The empirical results suggest that deviations from competition in the retail markets of major food groups were not statistically different from those obtained under perfect competition; though this is one example of an attempt at conjectural variation oligopoly in comparative statics in comparison with the perfect competitive hypothesis.

Lopez (1984) focuses upon the non-competitive behavior of the Canadian food processing industry, thus permitting an estimation of the degree of oligopoly power. The methodology is similar to that of Appelbaum (1982)—the performance of parametric tests for the measure of competition. The results statistically rejects the hypothesis of price-taking behavior. The average degree of oligopoly power is significant. The results also reveal that the industry's responsiveness to changes in the factor price structure.

Karp and Perloff (1989) is a study on the competitiveness of the export rice market which evaluates the level of competition in dynamic terms, rather than using conjectural variations. The objective of the analysis is to examine whether major rice exporting countries act as price takers or non co-operative
oligopolists. The use of dynamic models makes this paper distinctive. Linear quadratic open-loop and feedback models are used, since rice exporters cannot costlessly and instantly vary their output. Both classical estimations and Bayesian techniques are demonstrated. The method presented is useful in dynamic analysis, where the assumptions for the estimation of conjectural variations can give results incongruous to actuality.

In the context of the Japanese vegetable market, there are also several studies making use of conjectural variations analysis.

Matsuda and Kurokawa (1996) estimated conjectural variations and conjectural elasticities in the Japanese onion market. Two statistical tests are performed: whether conjectural variations are identical to certain numbers which specifies the locations of markets in the spectrum of oligopoly and whether there was a certain kind of collusion amongst producers. These methods were basically proposed in Iwata (1974) for the Japanese flat glass industry. However, due to the great variance in business practices between industry and agriculture, certain adjustments were applied, especially in the recognition of the marginal cost. The results show that the leading producers with large shares could not exercise monopoly or oligopoly power. Also, the hypothesis of the existence of collusion among producers was rejected. The market situation of onions in Japan is very similar to that of potatoes and so the method and implications presented here are largely applicable to the Japanese potato market with the exception of data availability and the degree of production concentration.
There are two studies which deal with the Japanese milk market under the assumption of imperfect competition. In Suzuki et al. (1993), conjectural variations are estimated to determine the degree of imperfection in the Japanese milk market. Using a conjectural variations model, comparative static analysis is applied under assumptions of both imperfect and perfect competition. The results indicate that the Japanese milk industry was imperfectly competitive though becoming more competitive; and also that fluid milk prices would decline less under an imperfectly competitive market than under a competitive structure with the milk support price reduced.

Given the assumption of imperfect competition in Suzuki et al. (1994), the effectiveness of generic milk promotion is evaluated. Using an imperfect competition model, it is possible to determine the price and fluid premium of milk endogenously, whilst under a price-taking hypothesis they are given exogenously. The results show a conventional perfectly competitive model would underestimate returns from milk promotion in terms of generic advertisement. These studies are good examples of the significance of evaluating price-taking behavior using conjectural variations in comparative statics.

There are also several studies concerning measurement of the level of competition in oligopsony.

Based on Appelbaum (1982), Shroeter (1988) extends conjectural variations analysis to the measurement of monopsony power. Data from the U.S. beef packing industry are examined. The results indicate the existence of
monopoly and monopsony price distortions in the slaughter cattle and the wholesale beef markets. This paper also discusses chronological examinations of market power based on estimated conjectural variations. Despite a trend toward increased concentration, market performance had not become less competitive.

In Koonz et al. (1993), market power in the context of oligopsony in regional fed cattle markets is measured with an econometric model of the margin between boxed beef and fed cattle prices. Tests for co-operative or non-co-operative conduct and measures of market power are presented. The econometric margin is given as a conditional regression which differs under co-operative and non-co-operative phases. Additionally, conjecture among companies is specified. The general finding is that market power had been exercised in fed cattle purchases during the early to mid 1980s with co-operative pricing conduct.

Lopez and You (1993) investigate the determinants of oligopsony power exercised by coffee exporters in Haiti. One equation for the Learner index of oligopsony and another for the residual supply function facing exporters are estimated. Empirical results reveal that both institutional arrangements and domestic market conditions were significant sources of oligopsony power. The concept of conjectural variation is utilized to measure market power in oligopsony as an indication of collusion, since the Lerner index directly depended on collusion.
In summary, there is a broad variety of literature which reports on studies of imperfect competition employing conjectural variations analysis. The merits and limitations of conjectural variations analysis are discussed in the literature with presentation of several alternative ways to evaluate the level of market competition on both supply and demand side. Having reviewed these previous studies in this chapter, conjectural variations analysis is employed as the methodology in the analysis of this thesis.
CHAPTER FOUR
ANALYSIS METHODOLOGY AND DATA

This chapter describes the methodology used for this study. Conjectural variations and conjectural elasticities of large production centers in four wholesale markets are estimated in order to measure the degree of competitiveness in the Japanese potato market.

In order to obtain conjectural variations, price elasticity of demand must be estimated by constructing demand functions in those markets. The construction of demand function will also present the nature of the Japanese potato markets.

4.1 Conjectural Variations

4.1.1 Definition and Criteria of Conjectural Variations

According to Varian (1992), “oligopoly is the study of market interactions with a small number of firms.”

When the market interactions are clarified by the theory of games, the models of firms’ behavior of profit maximization can be generalized using conjectural variations in the following manner.

Suppose there is an oligopolistic market with one homogeneous product. Let the total output of this market be Q, the market price p and the market inverse demand function expressed as:

\[ p = f(Q) \]
with the assumption \( \frac{df}{dQ} < 0 \)

Let the number of producers be \( N \) and the output of the \( i \)th producer \( y_i \). Then

\[
Q = \sum_{i=1}^{N} y_i
\]

(4.2)

Suppose each producer is a profit maximizing firm. Profit maximization of the \( i \)th producer is:

\[
\max_{y_i} \pi_i = p(Q) y_i - c_i(y_i)
\]

(4.3)

From a game theoretic viewpoint, each firm's output is decided by the interactional strategy. The total output is written as:

\[
Q = y_i + \sum_{i \neq i} y_j
\]

where

\[
y_j = f_j(y_i)
\]

Using these notations, (4.3) is written as:

\[
\max_{y_i} \pi_i = p(y_i + \sum_{i \neq j} f_j(y_i)) y_i - c_i(y_i)
\]

(4.3)'

The first order condition for (4.3)' is

\[
p(Q) + p'(Q)[1 + \sum_{i \neq j} f_j'(y_i)] y_i - c_i'(y_i) = 0
\]

(4.4)

As Varian (1992) explains, the term \( \sum_{i \neq j} f_j'(y_i) \) indicates producer i's belief about the ratio of variation of the other producers' output if it changes its own output. This term is defined as the conjectural variation of firm i about other firms and denoted as \( \gamma_i \).
Using \( y_i \) (4.4) is written as

\[
(4.5) \quad p(Q) + p'(Q)\left(1 + y_i\right)Q_i = c_i'(Q_i)
\]

The conjectural variation gives different first order conditions for the various models of oligopoly.

The criteria of conjectural variations is shown below\(^1\).

1. \( y_1 = 0 \)—this is the Cournot model where each firm's choice is independent from the other firm's;
2. \( y_1 = -1 \)—this is the competitive model where price equals marginal cost;
3. \( y_i = \sum_{j \neq i} f_j'\left(Q_j\right) \)—sum of slope of all other firm's reaction curve in terms of firm \( i \)—this is the Stackelberg model, as it is shown in the definition of \( y_i \);
4. \( y_i = Q/\gamma_i - 1 \)—this condition maximizes industry profits—the collusive equilibrium.

Conjectural variations ranges from the value for the competitive and one for the perfect collusion or monopoly case. Hence,

\[
(4.6) \quad -1 \leq \gamma_i \leq Q/\gamma_i - 1
\]

### 4.1.2 Conjectural Elasticity

As we can see from the expression (4.6), the upper value of conjectural variation depends on the market share \( y_i/Q \). To compare the degree of competitiveness among producers with different market shares, conjectural elasticity can be used. The definition of conjectural elasticity is:

\(^1\) Varian (1992) shows the criteria for the duopoly case. Here it is expanded to the general case with \( N \) firms.
Conjectural elasticity indicates producer i's belief about the ratio of variation of total output if it changes its output. From (4.6) and (4.7),

\[ 0 \leq \theta_i \leq 1 \]

When \( \theta_i \) is 0, producer i is a price-taker and when \( \theta_i \) is 1, there is a perfect collusion or a monopoly in the industry.

### 4.1.3 Estimation of Conjectural Variations

Conjectural variations can be calculated in the following manner. From equation (4.5):

\[ \gamma_i = \frac{c_i'(y_i) - p(Q)}{p'(Q)y_i} - 1 \]

\[ \Rightarrow \gamma_i = \frac{\frac{dQ}{dp} \frac{c_i'(y_i) - p(Q)}{y_i} - p(Q)}{y_i} - 1 \]

From this equation, we get the following form:

\[ \gamma_i = \eta \frac{c_i'(y_i) - p(Q)}{p} y_i - 1 \]

where \( \eta \) is price elasticity of demand in the market.

Empirically, the price elasticity of demand and a marginal cost of firm i can be estimated by constructing a demand function in that market and a marginal cost function of firm i. The estimated value of the conjectural variation of firm i can be obtained based on those estimations.
In construction of the demand function, the price \( p \) and demand \( Q \) may be determined simultaneously hence we may not be able to give \( p \) and \( Q \) as exogeneously determined values in this equation.

Iwata (1974) introduces some assumptions to deal with this condition. From (4.10),

\[
\frac{\gamma_i}{Q} = \frac{\eta c_i' - p}{p \gamma_i + 1}
\]

Summing up the left hand side,

\[
\sum_{i=1}^{\gamma} \frac{\gamma_i}{Q} = \frac{\eta \sum_{i=1}^{\gamma} c_i' - p}{p \sum_{i=1}^{\gamma} \gamma_i + 1}
\]

\[
\Leftrightarrow 1 = \frac{\eta \sum_{i=1}^{\gamma} c_i' - p}{p \sum_{i=1}^{\gamma} \gamma_i + 1} - \eta \sum_{i=1}^{\gamma} \frac{1}{1 + \gamma_i}
\]

Hence

\[
(4.11) \quad p = \left[ \eta \sum_{i=1}^{\gamma} \frac{c_i'}{1 + \gamma_i} \right] \left[ 1 + \eta \sum_{i=1}^{\gamma} \frac{1}{1 + \gamma_i} \right]
\]

From equation (4.11), if three elements \( \eta, c_i' \) and \( \gamma_i \) are constant and exogeneously determined, price can be treated as predetermined. Iwata (1974) presents the following three assumptions:

Assumption 1: The price elasticity of demand \( \eta \) is constant regardless of the level of demand.

Assumption 2: The marginal cost of each firm \( c_i' \) is constant with respect to its short-run variation in output.

Assumption 3: The conjectural variation \( \gamma_i \) is a constant parameter for each firm in each period.
As Iwata (1974) explains, these three conditions are not unrealistic. Assumption 1 is frequently applied when a log-linear type demand function gives a good estimation. Concerning assumption 2, concerning short-run variation of output, there has been considerable research supporting this supposition. The third assumption means that a producer's conjecture about other producer's behavior is restricted in terms of time period, which would be natural in actual economic activities. Hence in this thesis, these suppositions are also applied.

The second order condition of profit maximization (4.3)' is

\[(4.12) \quad (2 + 2\gamma, + \frac{d\gamma,}{dy,} \frac{dp}{dQ} + (1 + \gamma,) \frac{d^2p}{dQ^2} y, - \frac{d^2c,}{dy^2} < 0 \]

Assumption (1)-(3) are equivalent to \( \eta = \frac{dQ, p}{dp Q} = \text{const.} \), \( \frac{dc,}{dy,} = 0 \) and \( \frac{d\gamma,}{dy,} = 0 \)

Using these conditions, (4.12) becomes

\[(4.13) \quad \frac{1}{\eta} \frac{p}{Q} (1 + \gamma,) \left[ 2 + (1 + \gamma,) (1 - \frac{1}{\eta}) \frac{y,}{Q} \right] < 0 \]

To make (4.13) true,

\[(4.14) \quad \gamma, > -1 \]

is a necessary condition.

Through this discussion, potatoes have been treated as homogeneous products hence their price was denoted as \( p \). However, in real markets, the price of potatoes differs according to production area.

We assume that the ratio of price for one producer to the market price is constant for a short period of time. This relationship is written as:

\[ p, = r, p \]
where \( p_i \) is the price for producer \( i \) and \( r_i \) is constant\(^1\). Hence,
\[
\eta = \frac{p \frac{dQ}{dp}}{Q} = \frac{p_i \frac{dQ}{dp}}{Q_i \frac{dp}{Q_i}}
\]
Using this, the equation (4.10) is written as:
\[
(4.10') \quad \gamma_i = \eta \frac{c_i - p_i \frac{Q}{p_i}}{\gamma_i - 1}
\]
Conjectural variations and conjectural elasticities are estimated according to this equation.

### 4.2 Estimation Model of Demand Function

There are several previous studies that have dealt with the estimation of the demand function in Japanese vegetable markets. In this section, the estimation models used in those previous studies are presented and the model for this thesis is given based on these earlier studies.

#### 4.2.1 Previous Models

1. **Matsuda and Kurokawa (1996)**

   \[
   (4.26) \quad \ln Q_j = \alpha_0 + \alpha_1 \ln \frac{P_j}{WPI} + \alpha_2 \ln \frac{P_j}{WPI} + \alpha_3 \ln \frac{LEH \cdot NH}{CPI} + \sum_{i=1}^{11} \alpha_{is} D_{M_s} + u_j
   \]

   where

   * \( Q_j \): quantity traded in the \( j \) th wholesale market;
   * \( P_j \): average price in the \( j \) th wholesale market;
   * \( WPI \): wholesale Price Index (All Japan, General, Base year 1990);

\(^1\) This coefficient \( r_i \) is called the composition coefficient in Matsuda and Kurokawa (1996).
DY_i: dummy Variable to show the change of the price elasticity of demand;
LEH: expenditure per household (All Japan, General, worker's household);
CPI: consumers Price Index (All Japan, General, Base year 1990);
NH_i: the number of household in each city;
DM_s: dummy variables to show the monthly difference of the traded quantity;
\[ s=1\ldots11 \]
u_i: error term


To deal with monthly fluctuation of demand, the researcher employed 11 dummy variables. In his study, the period for analysis is comparatively long—20 years—hence the researcher used dummy variable, DY_i, to deal with the structural change in demand. For the period previous to when there might be the greatest change in the price elasticity of demand, DY_i=1 and after that DY_i=0. Matsuda and Kurokawa assumed that the income elasticity of demand was constant throughout the period.

EGLS with Prais-Winsten Transformation is used to deal with serial correlation.

\[(4.27) \quad \ln Q_t = b_0 + b_1 \ln P_t + b_2 \ln I_t + b_3 \ln A_t + b_4 T + \sum_{i=1}^{5} d_i \cdot D_i + u_t\]

where

- \(Q_t\): demand for the product (onions or potatoes) in period \(t\);
- \(P_t\): average price for the product in period \(t\);
- \(I_t\): expenditure per household in period \(t\) (in urban areas, general);
- \(T\): time trend;
- \(D_i\): monthly dummy variables \((i=1: 1\ for\ February\ and\ 0\ for\ other\ months; i=2:\ for\ March\ and\ 0\ for\ others; i=3: 1\ for\ October\ and\ 0\ for\ others; i=4: 1\ for\ November\ and\ 0\ for\ others; i=5: 1\ for\ December\ and\ 0\ for\ others)\);
- \(A_t\): variables for advertisement;
- \(u_t\): error term.

\(P_t\) and \(I_t\) are deflated by Consumers Price Index.

In his study, the objective was to measure the effect of advertisement on the demand for onions and potatoes. Hence, Kanayama introduces the advertisement effect variable which is given by the Pascal Lag Model.

This estimation model does not include population variable nor a consumer's taste variable. To deal with changes of those external circumstances, the model employs a time trend.

According to Kanayama, Japanese dietary habits make it difficult to specify substitutes for onions and potatoes. Hence there is no variable for substitutes in this equation.
In Ueji (1986), the same form is used as an estimation model for the demand for vegetables in Japan, with the exception of the advertisement variable which is excluded.

4.2.2 Estimation Model of Demand Function and Data

Based on the foregoing, this study presents the following model of demand for potatoes in Japan.

\[
\ln Q_i = \alpha_0 + \alpha_1 \ln \frac{P_i}{WPI} + \alpha_2 \ln \frac{DI_i}{CPI} + \sum_{t=1}^{t} \alpha_{t+1} DM_t + \alpha_{t+2} T + u_i,
\]

where

- \( Q_i \): quantity traded in the \( j \)th wholesale market;
- \( P_i \): average price in the \( j \)th wholesale market;
- \( WPI \): wholesale Price Index (All Japan, General, Base year 1990);
- \( DI_i \): disposable income in the city where the \( j \)th market is;
- \( CPI \): consumers Price Index (All Japan, General, Base year 1990);
- \( DM_t \): dummy variables to show the monthly difference of the traded quantity;
- \( T \): time trend
- \( u_i \): error term.

Data Period: Monthly data for ten years (January 1986-December 1995) for Sapporo, Tokyo, Fukuoka and for nine years (January 1986-December 1994) for Okinawa. In this research, the data period is shorter than that employed in Matsuda and Kurokawa (1995). From Figure 2.11 and Figure 2.12, there is a constantly
decreasing trend from 1986 to 1995. During these ten year period, it is debatable to assume that there was some significant structural change in the potato demand. Hence there price elasticity of demand is treated as constant for these ten years.

As an explanatory variable for consumer's income, disposable income in cities where those wholesale markets are located is employed. The use of expenditure rather than income used in previous studies may be explained by Japanese payment conventions: in public sectors and most private companies, the payment is not equally distributed over twelve months. In December, the payment is more than double that of other months and some employers also give bonus payment in the middle of a year. Hence, expenditure can provide a more accurate proxy of consumption in Japanese household. However, due to the restriction of data, disposable income is used here.

In Equation (4.28), to deal with the monthly fluctuation of marketed quantity, dummy variables $D_{Mi}$ are provided. As shown in Figure 13, the pattern of monthly fluctuations of those markets are quite different. Hence, the dummy variables are used for different months from markets to markets. Basically, they are employed for months when the demand is apparently higher.

---

1 From "Annual Report" by the Sapporo, Tokyo, Fukuoka and Okinawa Wholesale Markets
2 Four to six dummy variables are employed depending upon markets, rather than eleven dummies with one constant term. The reduction of the number of dummy variables may also be advantageous in an effort to avoid multi-collinearity.
Figure 4.1: Monthly Fluctuations of Marketing Quantity in the Four Markets (1986-1995)

A. Sappro: Monthly Fluctuations of Marketing Quantity

B. Tokyo: Monthly Fluctuations of Marketing Quantity
C. Fukuoka: Monthly Fluctuations of Marketing Quantity

D: Okinawa: Monthly Fluctuations of Marketing Quantity

or lower than that of average months, January and December. The dummy variables employed are shown in Table 4.1. To deal with changes in factors which are difficult to specify explicitly, such as population, consumers’ taste, complement and substitute, time trend is employed in the same manner as Kanayama (1994).

\( P_j \), the average price in the jth wholesale market, is deflated by the Wholesale Price Index. \( Dl_j \) the disposable income, is deflated by the Consumers Price Index. Logs of quantity, average price and disposable income are taken to linearize the equations.

The quantities and prices were from annual reports of the central markets—Sapporo, Tokyo, Fukuoka and Okinawa. Disposable income in each city is from the Management and Coordination Agency. The deflaters, CPI and WPI, are from the Management and Coordination Agency and the Bank of Japan.

4.3 Estimation of the Marginal Cost Function

To estimate conjectural variations in each market, next we must estimate the marginal cost function for each prefecture. In this study, the focus is on decisions of each prefecture about their shipment. The duration of production of potatoes themselves are generally three to four months and we assume that they do not change their plan of growing based on price fluctuation in the short run, such as weekly or daily fluctuations. Instead, each prefecture observes market situations and decides their shipment given certain level of its potato production.
Hence, in this study, the marginal cost means the marginal cost for collection and shipment.

In Iwata's study on the Japanese flat glass industry, Iwata constructed input function for the production of flat glass then converted it into monetary term to get the marginal cost function. In a industry case like this, the marginal cost can be acquired as marginal cost of over all production. Indeed, the producer can adjust its production plan based on their observation of market price and speculation about other firms behavior in the short run. (Iwata, 1974) The situation is different in many cases of agricultural production.

Matsuda and Kurokawa (1995) set down the collection and shipment cost function in the following way. The following equation expresses the cost when the i th production area ships its products to the j th market\(^1\).

\[
C_{ij} = \int_{y_i}^{\infty} \frac{dVC_i}{dy_i}dy_i + y_{ij}t_{ij} + y_{ij}FC_i
\]

where

- \(VC_i\): variable costs except transportation: (collection and shipment cost) - (depreciation allowance) - (marketing cost) - (capital interest) + (wholesale handling charge),
- \(y_i\): shipping quantity of the i th production area,
- \(t_{ij}\): unit transportation cost from the i th production area to the j th market,
- \(FC_i\): fixed cost: the portion of collection and shipment cost which is thought to be constant in the short run.

\(^1\) The notations are changed from Matsuda and Kurokawa (1995) following the previous parts in this thesis.
It is assumed that the unit transportation cost is independent on the quantity, or,
\[
\frac{dt_i}{dy_i} = 0.
\]

When the marginal cost is estimated, the fixed part, FCi is constant to the quantity. Hence we must obtain only VC_i and ti. Matsuda and Kurokawa used data by M.A.F.F. from 1973 to 1992 to estimate this variable collection and shipment cost for onions.

Matsuda and Kurokawa estimated the collection and shipment variable cost function using the following estimation model.

\[
(4.29) \quad \ln VC_i = \beta_0 + \beta_1 \ln y_i + u_i,
\]

u_i is error term. VC_i is realized by Agricultural Product Price Index (General, base year 1990).

The survey on collection and shipment cost for vegetables has been done by M.A.F.F. for more than 20 years. However, it turned out that the estimates for onions and potatoes were identical since they have very similar practices of collection and shipment and their bulk is similar. Therefore, now only the investigation on onions is done representing the collection and shipment costs of both onions and potatoes. In this thesis, due to this restriction of data, the result of the estimation by Matsuda and Kurokawa (1995) is utilized. The available data of collection and shipment cost from the report is for ten years—1986-1995—for this research whereas Matsuda and Kurokawa used the data for twenty years—1973-1992. There is no drastic change in the data from 1993 to 1995. Considering accuracy given by more observations, here the researcher uses the
figure estimated in Matsuda and Kurokawa (1995). When the regression of the variable cost is estimated against the shipping quantity of a production area, there occurs a fundamental numeric difference between potatoes and onions, since total production of these products are different. Hence, considering the collection and shipment cost is identical between onions and potatoes, assume the marginal collection and shipment cost is also identical. Hence the result of the regression for onions may be directly utilized here.

The unit transportation cost can be calculated by summing the ground fare by trucks and the shipping fare by ferries. The ground fare is given by "Table of Fare by Distance," by the Ministry of transportation. The ocean fare is gotten from each shipping company. The shipping is supposed to be between Hokkaido and Honshu and between Okinawa and Honshu.

Matsuda and Kurokawa (1995) obtained unit transportation cost by accumulating ground transportation cost and ocean transportation. The ground transportation fare was given by the standard price by the Ministry of Transportation. The ocean transportation was obtained from ferry companies. In this thesis, the estimation is based on the calculation by Matsuda and Kurokawa (1995) except the costs concerning Okinawa. The ground and ocean transportation cost from Fukuoka to Okinawa is added to the values estimated by Matsuda and Kurokawa.

1 Report on Collection and Shipment cost of Vegetables and Fruits, M.A.F.F.
4.4 Summary

The conjectural variation and conjectural elasticities are used as numerical measure of competitiveness of production areas of potatoes in Japan in this thesis. To get those estimators, price elasticity of demand in the four markets examined will be obtained using the estimation model presented in this chapter. The time period of the monthly data is ten years—from January 1986 to December 1995—except the Okinawa market—nine years. For the marginal cost of collection and shipment, there is restriction of data hence the estimation presented by Matsuda and Kurokawa (1995) is utilized. The results will be presented in Chapter Five.
CHAPTER FIVE

EMPIRICAL RESULTS AND INTERPRETATION

In this chapter, the results of the analysis are presented and their implications discussed. Firstly, the results of the estimation of demand function for potatoes in the four markets; secondly, the estimated conjectural variations and conjectural elasticities; and finally, the interpretation of those conjectural variations.

5.1 Results of Estimation of Demand Functions

In this section, the results of the regression analysis for the demand function in the four markets are explained. Constructing demand functions serves to present the nature of the demand structure in those markets and also to estimate conjectural variations using price elasticity of demand.

In the actual estimation, ordinary least squares estimation was initially applied. However, from the Dubin-Watson value, serial correlation among error terms was suspected. To deal with this problem, the Cochran-Orcutt method was employed.

Table 5.1 shows the results of the estimation.

---

1 The Cochrane-Orcutt method estimates $\rho$ from ordinary least squares residuals. The dependent and independent variables are then transformed in the form $\hat{X}_t = (1 - \hat{\rho})X_t$. The residuals from the transformed equation will be roughly serially uncorrelated. (Davidson and MacKinnon, 1993, pp334-35)
Table 5.1: Parameter Estimates of Demand Functions of Potatoes, 1986-95, monthly data

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sapporo</th>
<th>Tokyo</th>
<th>Fukuoka</th>
<th>Okinawa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>-0.2607***</td>
<td>-0.1850***</td>
<td>-0.0883*</td>
<td>-0.1289***</td>
</tr>
<tr>
<td></td>
<td>(-2.82)</td>
<td>(-2.98)</td>
<td>(-1.69)</td>
<td>(-4.12)</td>
</tr>
<tr>
<td>Disposable Income</td>
<td>0.2923***</td>
<td>0.0600**</td>
<td>0.0514*</td>
<td>0.0535***</td>
</tr>
<tr>
<td></td>
<td>(4.31)</td>
<td>(2.47)</td>
<td>(1.81)</td>
<td>(2.77)</td>
</tr>
<tr>
<td>Dummy Variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>February</td>
<td></td>
<td>0.1705***</td>
<td>0.0990***</td>
<td>-0.0793***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(6.10)</td>
<td>(30.68)</td>
<td>(-3.99)</td>
</tr>
<tr>
<td>March</td>
<td>0.1966***</td>
<td>0.2323***</td>
<td>0.1787***</td>
<td>-0.0858***</td>
</tr>
<tr>
<td></td>
<td>(2.79)</td>
<td>(7.40)</td>
<td>(5.04)</td>
<td>(-3.99)</td>
</tr>
<tr>
<td>April</td>
<td></td>
<td>0.2928***</td>
<td>0.2312***</td>
<td>-0.0952***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(8.38)</td>
<td>(5.66)</td>
<td>(-4.74)</td>
</tr>
<tr>
<td>May</td>
<td></td>
<td>0.4718***</td>
<td>0.3177***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(12.69)</td>
<td>(8.51)</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td></td>
<td>0.2940***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(10.10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July</td>
<td></td>
<td></td>
<td>-0.2225***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(-7.47)</td>
<td></td>
</tr>
<tr>
<td>August</td>
<td>0.8898***</td>
<td>-0.1334***</td>
<td></td>
<td>0.0452**</td>
</tr>
<tr>
<td></td>
<td>(12.32)</td>
<td>(-5.26)</td>
<td></td>
<td>(2.11)</td>
</tr>
<tr>
<td>September</td>
<td>0.9355***</td>
<td></td>
<td></td>
<td>0.1016***</td>
</tr>
<tr>
<td></td>
<td>(12.05)</td>
<td></td>
<td></td>
<td>(4.25)</td>
</tr>
<tr>
<td>October</td>
<td>1.0412***</td>
<td>-0.1383***</td>
<td></td>
<td>0.1014***</td>
</tr>
<tr>
<td></td>
<td>(13.73)</td>
<td>(5.63)</td>
<td></td>
<td>(4.20)</td>
</tr>
<tr>
<td>November</td>
<td>0.7873***</td>
<td></td>
<td></td>
<td>0.0816***</td>
</tr>
<tr>
<td></td>
<td>(10.18)</td>
<td></td>
<td></td>
<td>(3.4877)</td>
</tr>
<tr>
<td>Time trend</td>
<td>0.0007</td>
<td>-0.0202***</td>
<td>0.0003</td>
<td>0.0007**</td>
</tr>
<tr>
<td></td>
<td>(0.93)</td>
<td>(-4.33)</td>
<td>(0.64)</td>
<td>(2.23)</td>
</tr>
<tr>
<td>Constant</td>
<td>11.8635***</td>
<td>15.8473***</td>
<td>13.4150***</td>
<td>5.10781***</td>
</tr>
<tr>
<td></td>
<td>(20.98)</td>
<td>(67.99)</td>
<td>(56.79)</td>
<td>(32.04)</td>
</tr>
</tbody>
</table>

R^2: 0.7765  0.8202  0.6524  0.7334

Durbin Watson: 2.04**  1.98**  1.98**  2.08**

\(^{1}\) Log values are taken for price and disposable income. The parameters which are represented as - do not exist since the dummy variable for the month does not exist. The values in parentheses are the t-values of the respective variables.

*Significant at 10% level of confidence.

**Significant at 5% level of confidence.

***Significant at 1% level of confidence.
For both the Fukuoka and the Okinawa markets, $R^2$ is comparatively low. However, each parameter satisfies the theoretical condition of signs and t-values and the Durbin-Watson values are generally satisfactory.

In respect to income elasticity of demand, the values varied from market to market at comparatively low levels (0.0514-0.2923). This is explained by the fact that disposable income was chosen as the explanatory variable in this estimation. As a result of the high level of income in Japan, the influence of income could be relatively smaller upon the consumption of potatoes. In Kanayama (1994), consumer's expenditure was used for the explanatory variable for the consumption of onions. In his study, expenditure elasticity was varied at higher levels—0.4738-1.5376—than the results in this study.

In previous studies, the demand for vegetables was generally inelastic. In this estimation, price elasticity of demand for potatoes varies from -0.0883 to 0.2608. In Kanayama (1994), the estimated values in the Tokyo market were -0.0408 for onions and -0.0508 for potatoes. In Matsuda and Kurokawa (1995), elasticity of demand for onions varied from -0.0428 to -0.1551 from market to market.

According to the estimation, the inverse of estimated price elasticity of demand, $\left|\frac{1}{\eta}\right|$ varies from 3.834 to 11.325. This means that when shipments to a market decreases by 1 %, the price of potatoes increases by 3.8 %, to 11.3 %. This implies that a producer can increase profits by varying shipment in those markets.
5.2 Results of Estimation of Conjectural Variations and Conjectural Elasticities

In this section, estimated conjectural variations and conjectural elasticities are presented. Table 5.2 shows the estimated results from January to February in 1995\(^2\). When the shipment from a producer in a market is 0, the conjectural variation and conjectural elasticity diverge and hence cannot be estimated. Those months are shown by - in the table.

A necessary condition for the second order condition of a producer's profit maximization and theoretical range of conjectural variations, \(-1 < \gamma < 0\), is met with one exception. For example, in the case of Hokkaido in the Sapporo market for January, the conjectural variation is \(-0.7879\) and the conjectural elasticity 0.2121. This means that when Hokkaido increases its shipment in the Sapporo market by one percent, it speculates other prefectures' shipment decreases by 0.7879 percent and the total shipment in the market increases 0.2121%. Hokkaido tries to maximize its profits based on this conjecture.

In the case of Aichi in the Tokyo market for September, the value of \(\gamma\) is lower than the theoretical value of price maximization. In this case, at least on a monthly basis, the average price is lower than the average marginal collection and shipment costs.

The conjectural variation, \(\gamma\), depends on the inverse of market share, \(Q/y_i\). Accordingly, when the market share is minimal, the numerical values of the

---

\(^2\) For the Okinawa market, the year is 1994.
Table 5.2: Estimated Conjectural Variations and Conjectural Elasticities

<table>
<thead>
<tr>
<th>Production Area: Hokkaido</th>
<th>Market</th>
<th>Sapporo</th>
<th>Tokyo</th>
<th>Fukuoka</th>
<th>Okinawa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Month</td>
<td>γ</td>
<td>θ</td>
<td>γ</td>
<td>θ</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>-0.7879</td>
<td>0.2121</td>
<td>-0.8475</td>
<td>0.1376</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>-0.7885</td>
<td>0.2114</td>
<td>-0.8424</td>
<td>0.1371</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-0.7923</td>
<td>0.2077</td>
<td>-0.8262</td>
<td>0.1362</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>-0.7889</td>
<td>0.2127</td>
<td>-0.7814</td>
<td>0.1431</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>-0.7605</td>
<td>0.2196</td>
<td>-0.3952</td>
<td>0.1494</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>0.1634</td>
<td>0.2152</td>
<td>19.7966</td>
<td>0.1456</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>-0.6372</td>
<td>0.2230</td>
<td>14.3773</td>
<td>0.1341</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>-0.7849</td>
<td>0.2151</td>
<td>-0.7351</td>
<td>0.1470</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>-0.7876</td>
<td>0.2124</td>
<td>-0.8429</td>
<td>0.1397</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>-0.7874</td>
<td>0.2126</td>
<td>-0.8651</td>
<td>0.1320</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>-0.7983</td>
<td>0.2017</td>
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conjectural variation are very large. In all cases except the case of Aichi, the estimated conjectural elasticity, $\theta$, ranges between 0 and 0.22. As mentioned in chapter four, when the conjectural elasticity is 0, the producer acts as a price-taker. When the value is 1, there is perfect collusion or monopoly. From the range of the results, the producers are not perfect price-takers; however, the markets appear to be relatively competitive despite the high concentration of production.

Comparing the conjectural variations of Hokkaido in the four markets, the values in the Sapporo market are higher than in all other markets in all months. The values in the Tokyo market are higher than those in Fukuoka and Okinawa. The values in the Sapporo market vary between 0.2017 and 0.2230, while those in Tokyo vary between 0.1341 and 0.1494. In the Fukuoka and Okinawa markets, values exist between 0.0566 and 0.0678, 0.0157 and 0.0802 respectively. Hokkaido's behavior is closer to a price-taker in the Fukuoka and Okinawa markets than in the Sapporo market.

Comparing other producers in other markets, it can be seen that only Hokkaido ships its products to all four markets and only the Tokyo market obtains shipments from all eight production areas analyzed in this research. In the Tokyo market, conjectural variations of other producers, such as Shizuoka and Aichi, are generally higher in the months when Hokkaido has less shipments—March, April and May.

This observation is consistent with the fact that when the supply from Hokkaido is minimal at the beginning of the summer, the Sapporo market—
located in Hokkaido—and the Tokyo market obtain products from southern parts of Japan, such as Kyushu. During that period, as previously mentioned, producers in southern prefectures have comparatively greater opportunities to ship their products, local producers have increased market power. Later, when Hokkaido begins to ship its potatoes, the Sapporo and Tokyo markets are dominated by products from Hokkaido.

Figure 5.1: Herfindahl Index of Potatoes in Four Central Markets (1994)


Figure 5.1 shows the Herfindahl Index (H-Index) in each market. As mentioned in Chapter 1, the Herfindahl Index indicates the degree of fewness of firms in an industry. In July and August, the H-Index reaches its lowest annual point in the Sapporo and Tokyo markets respectively while this is not the case in
the Fukuoka and Okinawa markets. The implication, therefore, is that when the
competitiveness of products from Hokkaido is low in Sapporo and Tokyo, the
competitiveness of local products is high in Fukuoka and Okinawa, with fewer
production areas shipping to these markets. Hence, the H-Index in these
markets increases with fewer suppliers. On the other hand, in southern markets
such as Fukuoka, potatoes both from Hokkaido and local production areas are
traded and the H-Index decreases as the source of potatoes increases.

Compared to the results in the previous studies, the values of conjectural
elasticity were slightly higher. In Matsuda and Kurokawa (1995), conjectural
variations and conjectural elasticities of onions were estimated and the
conjectural elasticities were lower than 0.14. This also showed the competitive
structure of the onion market in Japan. In the estimation of the demand function,
the values of price elasticity of demand for potatoes were higher in this study
than those for onions in Matsuda and Kurokawa. Also, the concentration of
production is higher for potatoes than onions. Considering these points, the
results in this study seem reasonable comparable to those of Matsuda and
Kurokawa.

5.3 Discussion

Despite the highly concentrated production, even Hokkaido, the dominant
producer, exhibits competitive behavior according to this test. Numerically, this
is due to the fact that the demand structure is inelastic in price and also that the
marginal cost of each producer is close to the market price. The reason behind this may be explained by the contestability theory. MacDonald (1987) states:

"If there are no sunk costs, then entry will be profitable as long as price exceeds the incremental costs of providing service. If an incumbent seller sets a price above incremental costs, an entrant can enter the market, slightly undercut the price of the incumbent, and attract all of the buyers while making a profit. . . . As long as the market is perfectly contestable, the incumbent's best strategy will be to set price equal to incremental costs; consequently, prices and market structure will mirror the least cost structure of production, and monopoly or oligopoly will not present a welfare problem." (pp: 157)

In other words, though they have a considerably large share in markets, the incumbents or large scale producers must behave competitively in order to maintain their share when a certain number of potential competitors exist. In fact, the share of Hokkaido and all other prefectures has been stable as shown in Figure 5.2. And also, as shown in Figure 5.3, the food self-sufficiency rate for potatoes has been declining since 1970. This means foreign competitors also have increased pressure on the market. Concerning significantly lower marginal cost of production of Hokkaido compared to other prefectures, it is likely that foreign competitors have consequential influence on this price determination. In terms of onion markets, where the share of imports is higher
Figure 5.2: The Share of Hokkaido and Other Prefectures in Potato Shipping


Figure 5.3: Food Sufficiency Rate for Potatoes of Japan

(Source: Statistics of Japan, Prime Minister's Offices)
than that of potatoes, Matsuda and Kurokawa (1995) explain that higher price levels enlarge the share of imported products.

The results may support the theory that the large scale producers—Hokkaido and other main production areas—are maintaining competitive levels of prices, despite the fact that they are imperfectly competitive, in order to retain their market share. Hence, even though the production is highly concentrated, they are not behaving as monopolist or highly collusive oligopolists.

It is appropriate then, regarding the level of competition and the behavior of firm, to consider the significance of imports in the markets and the function of agricultural co-operatives in the volume and timing of shipments.

First of all, the extent of the analysis in this thesis is restricted to the market quantity in the four specified wholesale markets. Amongst these four wholesale markets, only the Tokyo market has imports from foreign countries. In 1995, the quantities were 620 metric tons from Taiwan and 2,730 metric tons from New Zealand, where the total volume traded was 120,665,300 metric tons. The quantity of imports from both countries is less than 0.01% of total supply. The estimation of conjectural variation in this chapter includes the effect of these volumes.

The market quantity in wholesale markets is comparatively small in the total market quantity of potatoes in Japan—31% as shown in Table 2.12. The bulk of imported potatoes supply material for, or arrive in the form of, processed food; most of potatoes sold through wholesale markets are for fresh consumption. As a result of these two conditions, the portion of imported
potatoes is very small, even in the Tokyo wholesale market. Hence, the influence of foreign producers as potential competitors in the market is not clearly visible from the analysis of wholesale market potatoes.

Additionally, the function of agricultural co-operatives may also affect the behavior of shippers. As explained in 2.6.2, the agricultural co-operatives in Japan have a very diversified function, with objectives that include contribution to the social welfare of agricultural areas. As shown in Table 2.9 in 2.6.1, the share of shipment by co-shipment is 50% of the total market quantity, of which 64% is by agricultural co-operatives. The market share traded by agricultural co-operatives totals more than 30%. It is possible that the social-welfare nature of agricultural co-operatives affects the price of potatoes in wholesale markets that function close to marginal costs. However, each agricultural co-operative is fundamentally independent of others and profit maximizing in practice. As discussed in Suzuki et al. (1994), an example of monopolistic behavior in a market of agricultural products exists where the marketed quantity through agricultural co-operatives is large. This point should be examined by a more precise investigation of the function of agricultural co-operatives.

5.4 Limitations of the Analysis

The analysis has some limitations. Firstly, by the very nature of conjectural variations analysis, it reduces a dynamic term to a static term. Three assumptions provided in chapter four—constant price elasticity of demand, constant marginal cost and constant conjectural variations in terms of changes in
market quantity—means that price, which should be simultaneously determined with quantity, is more or less given as a proxy in the model. Varian (1992) also points this out.

Secondly, for this thesis, the cost of collection and shipment for potatoes could not be acquired and those for onions were utilized instead. The marginal cost of collection and shipment of potatoes and onions are not significantly different; therefore, estimates for onions can serve as a proxy for those of potatoes. Also, due to this data restriction, the variance of the estimated marginal cost functions could not be obtained. As Iwata (1974) established, when the variance is obtained, two statistical tests—identification of the value of conjectural variation and the possibility of collusion among producers—could not be presented. Hence, the interpretation of the results is necessarily abstract, since this was pointed out as a weakness of conjectural variation analysis by Geroski et al. (1985).

Thirdly, since the conjectural variation analysis model for this thesis is constructed in terms of quantity, it does not reveal the nature of price leadership in the market. To examine the existence of price leadership, some other methods, such as conjectural variations in terms of price explained in Kamien and Shwartz (1983), or certain kinds of causality tests with a good series of daily prices would be employed.

Finally, as discussed by Kanayama (1994) and mentioned in chapter two in this thesis, as far as each prefecture is regarded as a producer, the analysis does not reveal behavior of individual farms or farm households, where the
market structure is that of conventional perfect markets. In order to microscopically analyze each producer, focusing upon individual decisions of each farm household, some other framework to define producers is required as well as other units of data such as daily farm gate price.

5.5 Summary

Besides some points which require more precise examination from a different perspective, the results of the analysis demonstrate that producers exhibit relatively competitive behavior in the wholesale market trade of potatoes in Japan.

The conclusions are presented in Chapter Six, with recommendations for further studies.
CHAPTER SIX
CONCLUSIONS

6.1 Main Findings

The production and shipment of potatoes in Japan are significantly concentrated in only one production area, Hokkaido. Under these conditions, there exists the possibility that the leading producers conduct oligopolistic power over the market and the market structure may therefore be far from that of perfect competition.

In this thesis, firstly the background of this concentrated production was investigated from the aspect of competition among producers, legislative framework and business practice in the market.

In terms of long term profitability, various advantageous factors exist for Hokkaido’s potato production. The most significant is sheer economy of scale. Also, the historical background relating to starch and food processing assisted in Hokkaido’s market dominance. Additionally, since the period of rapid economic growth in the 1960s and 70s, there were legislative incentives to form large vegetable production centers. These legislative incentives were introduced by the Central Wholesale Market Law and the Vegetable Production and Shipment Stabilization Act. The business practice of production and shipment, such as that of agricultural co-operatives, made prefectures recognized as units of production and shipment. The competition amongst producers formed through these business practices lead to the forming of large scale production areas and hence the concentration of production.
This thesis examined the level of competition in the Japanese potato market which was empirically analyzed employing conjectural variations. The level of conjectural elasticities was rather low for all producers analyzed including, Hokkaido. However, the producers were, in fact, behaving fairly competitively, even under this situation of highly concentrated production though the markets are not perfectly competitive. The level of conjectural elasticities was slightly higher than for onions in Japan in a previous study by Matsuda and Kurokawa (1995). This may reflect the fact that the concentration of production and shipment of potatoes in Japan is higher than that of onions. Comparing different producers, it was revealed that, during the months in which Hokkaido lacked fresh shipment due to its climate, other prefectures exhibited comparatively greater market power.

Hokkaido and other producers' share of shipments in the markets has remained stable over the last ten years. During this same period, the food sufficiency rate of potatoes in Japan has slightly decreased. These facts imply that Hokkaido and other large producers must act competitively in order to maintain their market share by setting the price close to marginal costs.

6.2 Recommendations for Further Studies

As explained at the end of Chapter Four, the analysis in this thesis has certain restrictions. In order to analyze markets with concentrated production and shipment further and more precisely, several points should be noted.
Firstly, due to restrictions of data availability, the marginal cost function used in this analysis is for onions. To estimate conjectural variations more precisely, employing some more precise estimate of the cost of collection and shipment of potatoes, such as data from each prefecture or tax data of shipping organizations, is recommended. Using the variance of estimated marginal cost and price elasticity of demand, two statistical tests to interpret the market situation can be done as presented in Iwata (1974).

Secondly, the nature of the agricultural co-operatives in Japan is ambiguous and complex, which may have significant influence on the competitive behavior of the large production prefectures. Further investigation concerning the co-operatives can make the interpretation of results or construction of the estimation model more precise.

Thirdly, the recognition of prefectures as producers was given by the investigation of the business practice in production, shipment and wholesale markets, as well as by the convention established in previous studies. Further investigation of the behavior of producers and shippers at prefecture level—how tightly they are organizing for shipping decisions and strategies—may reveal the nature of the market more accurately. Also, as Kanayama (1994) pointed out, each producer or farm household in each prefecture is very small and may behave exactly as a price-taker. The analysis of decision making in production itself should consider this point.

Fourthly, the focus of the empirical analysis in this thesis was the four specified wholesale markets and excludes a large quantity of potatoes traded
outside wholesale markets, such as material for processed food. Also, although the quantity of imported potatoes through wholesale markets is small at present, the analysis does not reveal the pressure of foreign countries as potential competitors. To evaluate the market power of all those incumbents and potential competitors, a model construction including broader parameters of the industry is recommended.

Fifthly, the conjectural variation model constructed in terms of quantity does not reveal whether there is existence of price leadership. One possible way to examine this would be to construct the conjectural variation model in terms of price, for example, explained in Kamien and Schwartz (1983). If an adequate series of daily prices for each region's product in each wholesale market is available, a causality test, such as the one based on Vector Auto Regressions model, would be performed.

Finally, the methodology in this thesis, conjectural variation analysis, contracts dynamic terms into static terms. Dynamic analysis, which allows the simultaneous determination of price and quantity in each part of the industry, may be required according to the objectives of the analysis.
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