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EFFECTS OF FARM SIZE AND LAND TENURE ON THE ECONOMIC EFFICIENCY OF RICE FARMING IN KOREA

University of Hawaii

Ph.D. 1984

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EFFECTS OF FARM SIZE AND LAND TENURE ON
THE ECONOMIC EFFICIENCY OF RICE FARMING IN KOREA

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE
UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY
IN AGRICULTURAL AND RESOURCE ECONOMICS
AUGUST 1984

By
Kwangsuck Lee

Dissertation Committee:
Hiroshi Yamauchi, Chairman
Harold L. Baker
Jack R. Davidson
Gary R. Vieth
Yong-ho Choe
ACKNOWLEDGEMENTS

There are no adequate words to fully acknowledge and thank all who taught, guided, supported, and encouraged me in the course of successfully completing my studies. First of all, I am thankful and deeply indebted to my dissertation committee: My committee chairman, Dr. Hiroshi Yamauchi, who provided scholarly guidance, particularly emphasizing philosophical attitudes in dealing with research problems; Drs. Harold L. Baker, Yong-ho Choe, Jack R. Davidson, and Gary R. Vieth, who were always supportive and provided valuable comments toward the significant improvements of this manuscript.

Other faculty members to whom I want to express gratitude are Dr. Shelley Mark, who provided a financial support in the form of a research assistantship during the latter stages of my study; and Dr. Peter V. Garrod, who always responded to my technical questions on model development.

I am thankful to the East-West Center which provided me with a full four year grant for my studies at the University of Hawaii. Thanks are also due to Dr. Bruce Koppel at the
East-West Resource Systems Institute who generously supported me in planning my field trip in Korea. I deeply appreciate Mr. Jeung-Boo Kim at the Korea Rural Economics Institute who shared his valuable time in designing the scope of this study while I was at the Institute on my field study from December 1981 to July 1982.

I am indebted to Dr. Young Kun Shim and Professor Byeong-Do Kim, my former advisors at Seoul National University and Yeungnam University in Korea, respectively, for their continuous encouragements in my academic endeavors and my personal matters as well.

Of course, my parents deserve my sincere acknowledgement. No other persons could have spiritually supported me more than them while waiting for their son's fulfillment of his academic goal. I must acknowledge my younger brother, Geung Hee, and his wife. They have been respectfully taking care of our parents on behalf of myself while I have been studying in Hawaii.

There is one more person to whom I am indebted for the completion of this dissertation: Haesung, my wife. She has supported and encouraged me with her tireless devotion and spirit of selflessness even while she has been in pursuit of her own Ph.D in History at the University of Hawaii.
ABSTRACT

The purpose of this study was to compare the economic efficiencies of different farm size classes and to examine the effect of share tenancy on the use of variable inputs by tenant farmers in rice farming in Korea.

The research problems originate from the fact that the current change in farming structure in rural Korea appears to conflict with present land law which limits farm land size at 3 hectares and prohibits tenancy practices. The decreased number of farms, the decline in the rural population, and increased tenancy practices in spite of the law require a reconsideration of the current land law with respect to defining appropriate farm size and to evaluating the tenancy prohibition provision.

Economic efficiency in relation to farm size was analyzed by the concepts of relative economic efficiency and economies-of-scale. The profit function model was used for the analysis of relative economic efficiency, and the scatter diagram approach and the survivor technique were employed for the economies-of-scale analysis. The results suggest that in producing rice, the average farm size in
Korea, which is about 1.0 hectare, was smaller than the efficient farm size, which appeared to be 1 to 2 hectares in 1977. Farms cultivating less than 1.0 hectare comprise about two thirds of total farms in Korea. When agricultural income per capita is concerned, farms more than 2 hectares in size could be viable when compared with urban household income per capita and GNP per capita.

The allocative efficiency of share tenancy was analyzed by the method of the profit function model. The tenant farmers whose leased lands were more than 50 percent of the total cultivated paddy lands showed that they maximized their own share of total revenue: total value product minus variable input cost and rental payment. This implies that sharecropping practices are not desirable forms of rental arrangements when resource utilization by tenants and the overall farming efficiency are concerned.

An econometric demand function for lease land of tenant farmers was estimated by using variables suggested by competitive land rental market theory: i.e., rental payment per unit land, owned land per family labor, and capital per family labor. The result did not support the existence of such a competitive land rental market. The unsanctioned tenancy practices and the presently supply-dominated land rental practices may be factors influencing the tenants'
behavior in leasing lands other than those defined in a competitive market theory.
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Chapter I

INTRODUCTION

1.1 BACKGROUND OF THE PROBLEM

In the modern economic growth of nations, the relative decline of agriculture in the overall economies raises the important question on the role of agriculture in sustaining economic growth. A typical case of such an occurrence is, within the last two decades, the rapid transformation of Korea from a primarily agrarian to a mixed-industrial economy.

The structure of Korean agriculture has presently been considerably changed. The number of farms and the rural population have been sharply reduced as migration from rural to urban areas continues. This is due primarily to rapid economic growth since the late 1960s that has brought forth urbanization and industrialization. From 1965 to 1980, the number of farms decreased by 14 percent, while the rural population declined 32 percent, dropping from 55 percent of the total population in 1965 to 28 percent in 1980 (Table 1.1).
TABLE 1.1
Number of Farms and Farm Population Trend, 1965-1980

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Farms</th>
<th>Farm Population</th>
<th>Farm Population to Total Population (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td>2.51 millions</td>
<td>15.8</td>
<td>55.2</td>
</tr>
<tr>
<td>1970</td>
<td>2.48</td>
<td>14.4</td>
<td>45.9</td>
</tr>
<tr>
<td>1975</td>
<td>2.38</td>
<td>13.2</td>
<td>38.2</td>
</tr>
<tr>
<td>1980</td>
<td>2.16</td>
<td>10.8</td>
<td>28.4</td>
</tr>
</tbody>
</table>


The phenomenon of out-migration has resulted in labor shortages in rural areas necessitating the adoption of labor saving technologies which are aimed at improving farm efficiency. The problem of labor shortages becomes especially severe in the planting and the harvesting seasons. So far, farm mechanization that has been introduced is limited to land tilling and pesticide spraying. This level of mechanized farming practice does not seem sufficient in mitigating problems of labor shortages. Another difficulty is that the scale of farming is not large enough to justify highly mechanized farm
technologies. On the other hand, farm lands which cannot be managed by remaining family members tend to be fully or partially leased out. Tenancy practices can also be created when the amount of land supplied by migrating farmers cannot be purchased by farmers who remain in rural area. In addition, some urban bound farmers want to keep their land under tenancy because land is the only property on which they can rely in the event of bankruptcy in urban living. As a result, tenant farming has become an increasing trend. According to the 1970 Agricultural Census, about 34 percent of total farms were identified as full or partial tenant farms.

Current land law in Korea originates in the land reform law of 1950. Legally, farm size is limited to a 3 hectare ceiling and tenancy is prohibited. A conflict has arisen between the actual farming structure and the land law in Korea. Accordingly, the legal provision limiting acreage and prohibiting tenancy have become controversial issues. Indeed, the two problems are not independent of each other, but, rather, they are intertwined.
1.1.1 The Problem of Farm Size

Farm size problem has been raised since 1968 when the Korean government suggested a relaxation of 3 hectare land ceiling. It was argued that expansion of farming scale is necessary to economically use labor-saving farm machines. This is believed to be a critical condition for modernizing Korean agriculture. In addition, it is insisted that the farm size limitations be removed in order to develop a self-supporting farming structure through scale expansion which would result in balanced growth between the agricultural sector and the non-agricultural sector.

The opposing argument is that if the land size ceiling were removed, then urban capital would purchase most farm land, creating extreme land concentration or a land aristocracy. Thus this would lead to the collapse of the small peasant-farming system. When the landless peasants become tenants, a feudal tenancy system would be revived or unemployment would spread in the rural area. The argument

---

1 The peak of labor shortage problem in producing rice reaches in the seasons of rice transplanting and harvesting. A research reports that 7.7 hectares and 5.7 hectares of land are required to use a rice-transplanter and a cutter, respectively, at least meeting a break-even of benefit and cost, as cited by Oh (p. 63).

2 Oh (pp. 160-161) estimates a required land size per farm for assuring per capita farm income equal to 60 percent of GNP per capita is at least 4.0 hectares in 1991 under the assumption that GNP per capita will reach $4,000 in that year.
concludes that ultimately food production would be drastically reduced due to decreases in productivity.

1.1.2  **Tenancy Problem**

Those who advocate the legalization of tenancy practices have argued that farm size can be flexibly adjusted through a rental system when a farmer needs to expand his farming scale. This argument also takes into consideration the favorable bargaining power of tenants as the labor shortage tends to favor tenants when entering into rental negotiations. Thus it precludes any possibility of re-creating a traditional tenancy system and a polarization of land holdings. In addition, when the land, made available by an out-migration, cannot be purchased by other farmers in the rural community, the legal constraint on the tenancy practice loses its efficacy. Therefore, the prevailing practices of disguised tenancy that presently exist would be less reasonable or less efficient than if the tenancy system would be institutionally allowed.

Others who are in opposition to these arguments hold pessimistic views on the open tenancy system. They argue that currently existing tenancy practices are not much different from those of high rental contracts. Thus, if tenancy is legally supported, then the relationship between
landlords and tenants will certainly become that of a semi-feudal or feudal tenancy system. Under these conditions, investment would not be made in land improvements, and land utilization and productivity would decrease.

1.2 RESEARCH PROBLEM

The arguments concerning the farm size and land tenure system in Korea have been continued since the late 1960s. However, the problems and disputes have remained almost unchanged. Neither argument is sufficiently strong to resolve the issue, and more empirical analysis with respect to socio-economic concerns are needed.

In facing the issue of appropriate farm scale in Korean agriculture, the following two areas must be addressed: (1) the question of economic efficiency under the continuing farm size limitation of 3 hectares; and (2) the question of the expected economic efficiency under the assumption of no legal barriers to size, and the viability of farms in relation to sizes.

In fact, most empirical analyses of the effect of farm size on economic efficiency in Korea might give answers to the first question. Even though there are some farms cultivating more than 3 hectares, they are not completely
free of legal constraints. Thus, they cannot be regarded as operating large scale farms like those found in more developed countries such as the United States and Canada. Hence, farm size analysis with the empirical data in Korea would suggest a direction for a structural adjustment under the assumption that the present legal constraint on the farm size will not change.

The second question is more conceptual than the first. Evidence on the level of economic efficiency of farms cultivating more than three hectares is difficult to obtain. However, efficiency in those farms must be addressed, if only in conceptual terms, if we are to find an appropriate farming scale. Formulation of a methodology for estimating efficient farm scale may be of particular benefit in discussing the economic implications of continued use of the three hectare legal limit on farm size. Moreover, the viability of farms of different sizes is an important question when determining the balanced-income level between agricultural and non-agricultural sectors.

Even though tenancy is prohibited by the land law, excluding some exemptions, the tenancy practices are a known fact. Data on tenanted land, and the rents paid, are

---

3 When farmers are unable to operate their farms due to disease, education, military service, and so forth, they can rent out their land to other farmers for a short period.
collected and published by the government. This implies that the tenancy cannot be strongly controlled by the current Korean land law.

The effect of tenancy practices on economic efficiency in agriculture is an important question. Resource allocation under tenancy, especially share tenancy, has been considered both efficient and inefficient in recent theoretical discussion of the problem (Cheung 1969a; Ip and Stahl). If we can understand the level of resource allocation under share tenancy, then we can provide policy implications for the possible forms of rental contracts.

1.3 RICE IN KOREAN ECONOMY

Rice is the most important single crop in the Korean economy in terms of both food production and consumption. Rice is planted on most paddy fields, which occupied 59 percent of the total cultivated area in 1980. For farm households, rice is a major product determining farm income because of its predominance in the production pattern. In 1980, rice provided about 49 percent of the average gross farm receipts. Rice is also accounted for 35 percent of total food consumption in 1979 (Kim and Jeo, p. 3). This

---

4 Ministry of Agriculture & Fisheries, Korea, Statistical Yearbook of Agriculture and Forestry, 1981.
5 Ibid.
study will consider rice farming to be the problem area for the examination of economic efficiency in relation to farm size and land tenure.

Korean rice farming has experienced a number of changes in production practices and technologies during last decade. Rice production increased significantly in the 1970s due to the diffusion of high yielding varieties. Production increases were facilitated by government programs such as price supports and fertilizer subsidies for planting high yielding varieties. The trend of production increase, however, did not continue after a record high yield in 1977 which resulted in self-sufficiency in rice production. After 1977, Korea had to import a great amount of rice in order to meet domestic demand (Table 1.2).

High government financial deficits stemming from the expenditures on price supports and fertilizer subsidy programs have had a two fold impact on rice farmers. Not only has it permitted increased production, but, as these deficits accumulated, the Korean government has changed the food grain purchase program in terms of the supported price level and quantities purchased. In addition, price

---

6 It is believed that the accumulated grain management deficit is a source of inflation, since the price support and fertilizer subsidy programs have been financed through overdrafts from the central bank rather than drawn from the national budget (Kim and Joo, p. 16).
TABLE 1.2
Rice Production and Import

<table>
<thead>
<tr>
<th>Year</th>
<th>Rice Production</th>
<th>Rice Import</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,000 M/T</td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>3,939</td>
<td>541</td>
</tr>
<tr>
<td>1975</td>
<td>4,669</td>
<td>481</td>
</tr>
<tr>
<td>1977</td>
<td>6,001</td>
<td>-</td>
</tr>
<tr>
<td>1980</td>
<td>3,550</td>
<td>580</td>
</tr>
</tbody>
</table>


Stabilization policies have stimulated the importation of staple food, including rice. Consequently, it would depress farm income and output. This may further stimulate rural-urban migration which will, in turn, create a greater shortage of agricultural labor.

1.4 OBJECTIVES OF THE STUDY

The main purpose of this study is to clarify the relationship between farm size and economic efficiency in Korean rice farming, and to analyze the allocative efficiency of tenant farming. The specific objectives are:

1. to compare economic efficiency by farm size,
2. to estimate the trends of resource adjustment toward the optimality condition in each farm size,
3. to examine the expected economic efficiency beyond the 3 hectare farm size and the viabilities of farms at various scales.
4. to analyze the allocative efficiency of farming under tenancy,
5. to examine factors affecting tenant decisions on leasing farm land, and
6. to suggest policy implications on the re-examination of the current land law in Korea.

1.5 HYPOTHESES AND SCOPE

This study sets the following two working hypotheses:

1. Within the context of the 3 hectare limitation of farm size, higher economic efficiency of rice farming is associated with the medium farm size (1 to 2 hectare) class.

2. Sharecropping tenancy results in allocative inefficiency in the use of variable inputs.
1.5.1 Rationale for Hypotheses

Traditionally, rice farming in Korea has been characterized by labor-intensive practices. However, the recent trend of declining farm population necessitates farm mechanization. Farm machines which are adopted in rice farming include power-tillers, power-sprayers, power-threshers, etc., since the large machines like tractors, combines, and rice-transplanters are not economical for small farms. Some important farm operations such as rice transplanting and harvesting still rely on farm labor. Peaks in labor shortages are reached at the periods of rice transplanting and harvesting. In this respect, the major determinants of economic efficiency of rice farming in Korea would be the following: 1) the available labor supply to effectively perform the labor-intensive farm operations; and (2) the availability of machinery adaptable to farms of 3 hectares or less. As farm size becomes smaller, the farm operations are increasingly more labor intensive. On the other hand, larger farms may employ a greater percentage of capital inputs. Larger farms may often display increased efficiency through the use of these inputs. However, on smaller farms, where labor is generally more available, peak period labor shortages are relatively less severe than for larger farms. It appears that efficiency in the use of
labor may override efficiencies resulting from increased use of capital equipment adaptable to the current farming scales. Thus we may hypothesize that higher economic efficiency of rice farming is associated with the medium farm size under the current farming structure.

An earlier study shows that sharecroppers represented 32 percent of the total tenant farmers surveyed in 1977 and that the rate of sharecropping rent was, on the average, 35 percent of the rice produced in the leased land (Oh, pp. 51-53). Even though the proportion of share tenants and the rate of proportionate rent decreased recently, sharecropping tenancy still comprises one third of prevailing rental arrangements.

A review of literature reveals that the allocative efficiency of share tenancy depends on the market system. Cheung (1969a) insists that an equilibrium under a competitive market system will lead to efficient resource allocation of share tenants. However, in Korea, tenancy practices have been legally prohibited since 1950. Thus there has been no well defined rental market that could systemize rental arrangements. Most forms of rental contracts are not institutionally protected. The rental market system in rural Korea does not seem to satisfy the conditions required for a competitive market. Under this
situation, it is hypothesized, a sharecropping tenancy will result in allocative inefficiency relative to owner cultivation.

1.5.2 **Scope and Procedure**

The concepts of relative economic efficiency and economies-of-scale are adopted as tools in analyzing the relationship between farm size and economic efficiency. Since both methods are static, the factor adjustment behavior of farms toward partial equilibrium over time is also analyzed. In addition, the farming scale is further examined with respect to the expected economic efficiency and farm viabilities beyond the 3 hectare barrier.

Allocative efficiency is tested to see if tenant farmers are utilizing variable inputs at optimum levels. In addition, factors influencing the amount of land under tenancy is investigated in the framework of demand and supply sides in a rental market.

In the process of accomplishing these tasks, Chapter II presents the institutional background of Korea's current land law. Chapter III contains a review of current literature on the farm size and economic efficiency, and on land tenure and allocative efficiency.
In Chapter IV, analytical models are explained which will be used in the analysis. These models include the profit function for the analysis of economic efficiency, the survivor technique and the scatter diagram approach for the analysis of economies-of-scale, and the distributed lag model for the analysis of the dynamic adjustment of resource use.

In Chapter V, the empirical findings are reported from the analyses of relative economic efficiency by farm size, the economies-of-scale, and the dynamic resource use adjustment by farm size. In addition to the above analyses, the discussion is further opened up about the economic efficiency associated with farm size beyond the 3 hectare limitation.

Chapter VI analyzes allocative efficiency by tenant farmers and examines factors determining the size of rented land.

Finally, Chapter VII summarizes the research findings and suggests policy implications with regard to possible changes in farm structure.
Chapter II

INSTITUTIONAL BACKGROUND OF THE LAND LAW IN KOREA

2.1 INTRODUCTION

The underlying justification for land reform in developing countries can be found in the following statement:

In many peasant countries of the old world, the average landworker operates only slightly above the subsistence level. His desire to shift to a higher scale is frequently limited by custom, by his lack of capital and know-how, by his relative inability to acquire additional land in his home community, and by the absence of public policies and programs for this purpose (Barlowe, p. 151).

In this respect, land reform is one of the strongest measures used to direct publicly controlled change in the existing character of land ownership in countries where the great majority of the people are dependent upon agriculture and where outmoded tenure systems have favored small classes of landlords. This principle was applied in Korea when land reform was enacted in 1950.
2.2 **PRE-LAND REFORM PERIOD**

Prior to land reform, the land tenure system in Korea has been termed semi-feudal (or feudal in some cases). The size of land holdings determined the social position of the landlord, and a traditional subordinate relationship existed between landlords and tenants. Moreover, the marked characteristics of the land tenure system can be depicted by high rents and insecure tenant rights. In addition, Korea was under the Japanese rule from 1910 to 1945. Thus the land tenure system was closely related to Japanese ruling policies, such as Japanese landownership and taxation, which secured the staple foods for Japan during World War II.

The scale of farm management was small. About 90 percent of farm households cultivated less than 2 hectares, and the tenanted land was 63 percent of the total cultivated area (see Table 2.1). Under most tenancy contracts, rents were as high as 60 percent of the crop yield (Pak 1956, p. 1015). In addition, tenants themselves had to pay for costly fertilizers, farm implements, seeds, and other inputs. Along with these conditions, the semi-feudal relationship between landlords and tenants was reinforced because landlords had the right to terminate leases at will.

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7 About 62 percent of the landowners holding more than 100 hectares was Japanese in 1927 (Choi 1970, p. 352).
TABLE 2.1
Changes in Household Distribution by Farm Size and Land Area
Farmed by Tenants - Before and After Land Reform in Korea

<table>
<thead>
<tr>
<th>Classification</th>
<th>Pre-Reform (1945)</th>
<th>Post-Reform (1955)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>I. Household Distribution by Farm Size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Less than 0.5 ha</td>
<td>35.5</td>
<td>43.1</td>
</tr>
<tr>
<td>b. 0.5 - 1.0 ha</td>
<td>32.5</td>
<td>31.1</td>
</tr>
<tr>
<td>c. 1.0 - 2.0 ha</td>
<td>22.2</td>
<td>20.1</td>
</tr>
<tr>
<td>d. 2.0 ha and over</td>
<td>9.8</td>
<td>5.7</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

II. Land Cultivation by Tenure Status

<table>
<thead>
<tr>
<th></th>
<th>%</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Owner-cultivated Area</td>
<td>37</td>
<td>82</td>
</tr>
<tr>
<td>b. Tenanted Area</td>
<td>63</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Sources: Choi (1958, p. 125), King (pp. 198-223), and Pak (1968, p. 106)
2.3 **THE ENFORCEMENT OF LAND REFORM**

2.3.1 **Background and Objectives**

After independence, Korea's most important goals were securing social and political stability, and boosting economic development. The deep-rooted historical problem of the land tenure system was an urgent economic and social issue. Almost 80 percent of the total population was in rural areas where the demands to eliminate the traditional tenancy system had been growing. Moreover, in 1946, North Korea had enacted land reform in the scheme of collective confiscation and free redistribution of the land. This stimulated political pressures for land reform. At this point, even landlord classes, which had resisted land reform, agreed to the principles of reform. In short, the economic and social conditions had made land reform inevitable when Korea regained its independence.

Land reform in Korea was directed by the US Occupation Forces. Upon recommendations of Occupation Force administration, the government of Korea designed land reform laws. However, the government and the national assembly did not reach a consensus on the land reform bill until 1949. A reconciled bill was passed at the national assembly in April 1949, and land reform was declared by government in June 1949. Because the law was roughly prepared, it
contained many inconsistencies, and, it had to be revised by the national assembly before enforcement could proceed. Finally, a revised land reform law was approved in 1950 and enacted in the same year.

The objective of land reform in Korea was to enact the principle of "land to the tiller" or "owner-farmer establishment". Upon this principle, modern type of land ownership could be established, and farming efficiency could be enhanced. In this respect, Article I of the Land Reform Law states that "The purpose of this law, based on the Constitution, is, by means of an appropriate land redistribution, to improve farm welfare and to achieve a balanced economic development through establishing a self-supportive farm economy and increasing agricultural productivity."

2.3.2 Scope and Procedure of Enforcement

The 1950 legislation established a ceiling of 3 hectares on farm ownership and declared most forms of tenancy illegal. Land redistribution was based on these provisions.

The land area targeted for redistribution consisted of the confiscated lands from Japanese owners and the land compulsorily purchased by government. The following types
of land were purchased by the government under the land reform law: (1) land owned by non-farmers, (2) land not cultivated by owners, (3) the portion of land beyond 3 hectare ceiling, and (4) cultivated farm lands, other than orchards, for the farms which cultivated more than 3 hectares of orchard lands. When the above lands were purchased, the government paid the owners through a land bonds equal to 150 percent of the standard annual output of the land. This payment was to be cleared in 5 years with annual installments of principal and interest. These lands, whether confiscated or purchased by the government, were in turn sold to farmers according to legislated priority, which follows: (1) farmers currently cultivating the land which was targeted for redistribution, (2) farmers cultivating a very small area in relation to their households' capabilities, (3) bereaved families, (4) agricultural laborers, and (5) farmers who returned from abroad. Farmers who purchased land from the government had to pay 150 percent of the average output. The payment was supposed to be made in kind and be finished in 5 years in terms of equal annual payments.

By 1957, a total of 470,022 hectares was distributed. Fifty seven percent of this total was purchased by the government and the remaining 43 percent was confiscated land
of Japanese owners. This area was distributed to 66 percent of the total farm households, and the average beneficiary received a farm area of 0.35 hectares. However, the distributed area constituted only 35.5 percent of total tenanted land prior to land reform (Choi 1965, p. 127; King, pp. 222-223; and NACF, p. 69 and p. 98).

2.3.3 Results of Land Reform

Although there are controversies concerning the results of the land reform, most scholars agree that the land reform was successful and marked the turning point in the transition of the land ownership system from a feudal or semi-feudal system to a modern ownership system. In addition, land reform resulted in removing potential sources of social and political unrest, especially during the Korean War.8

However, land reform could not fully fulfill the goals it sought. In spite of the fact that the land reform outlawed tenancy, the tenant and part-tenant (part-owner) comprised 30.5 percent of the farm households in 1965, and this ratio increased to 36.1 percent in 1977 (Oh, p. 44).

8 In this regard, Pak (1956, p. 1021) states that "In fact, land reform saved human lives, particularly for landlords because there could have been serious rioting against landlords by landless peasants."
This trend was caused, in part, by the fact that beneficiary farmers of land reform often could not keep purchased land after the payment period. This resulted primarily from a lack of capital to operate farm. Survival in farming was affected by the following conditions: (1) The short repayment period (5 years), (2) the high monetary interest (24 percent per annum), and (3) the stipulation of repayment in kind. After the land reform, administrative defects were found in the lack of institutional supports, such as credit facilities and extension services. As Ledesma (p. 37) notes:

... even though patterned after the Japanese model, the Korean experience did not fare as well ... for lack of government auxiliary services ...

Such adverse conditions often forced the farmer to illegally sell part of his land even before the legal repayment period ended, giving rise to a new breed of tenant farmers.

In addition, political considerations affected the legislative process. At first, many conservative politicians and landlords resisted land reform concepts. But as some sort of land reform became inevitable, landlords began to sell their lands under conditions favorable to them before the reform could be implemented. By the time land reform was enforced, the area of land affected had been drastically reduced. The inadequate and inefficient
administration of the time offered ample opportunity for landlords to register their lands under various disguised forms of ownership. The absence of land reform to apply to forest land and orchard land also permitted landlords to preserve their landed properties to some extent. Moreover, the outbreak of the Korean War in 1950 retarded the enforcement of legislation. As a consequence, by the year 1957, the redistributed area was only 35.5 percent of the total tenanted area and only 45.9 percent of the area that the government initially planned for redistribution (Choi 1958, p. 127).  

According to Oh (p. 15), as of 1961, the redistributed area was 37 percent of the total tenanted land and was 63.7 percent of the targeted area.
Chapter III
REVIEW OF LITERATURE

This chapter reviews the relevant literature on the problems of farm size and land tenure in relation to economic efficiency. The review covers the theories and methodologies used in analyzing economies-of-scale and relative economic efficiency. For the land tenure problem, consideration is given to literature on allocative efficiency. Literature reviewed in this context involves theories concerning the effect of tenure systems, particularly sharecropping tenure, on the use of variable inputs.

3.1 FARM SIZE AND ECONOMIC EFFICIENCY

Farm size has long been an important issue in agricultural economics. While the issue deserves substantial attention for a number of reasons,10 'efficiency' has been an analytical focus in production.

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10 Stanton (p. 727) summarizes an important mixture of the reasons: 1) poverty in rural area and minimum level of living for farm people, 2) business management of individual farm, 3) efficiency, and 4) distribution of agricultural resources.
economics. With the concept of efficiency, we may consider the least cost use of a given bundle of resources for individual farm units and, also, across whole groups of farms.

There are basically two concepts for the analysis of efficiency and farm size: economies-of-scale and relative economic efficiency. The two are not mutually exclusive for the purpose of farm size analysis. The concept of economies-of-scale helps to determine the best advantages in production when a firm adjusts scale or size. On the other hand, the relative efficiency concept enables one to compare levels of economic efficiency between different firms, or firm size groups. While the economies-of-scale concept theoretically compares the most efficient firm in each scale or size, the relative economic efficiency concept may not always include the most efficient operation in each scale or size.

3.1.1 **Economies-of-Scale**

Where the relationship between farm size and economic efficiency is concerned, Jacob Viner's long-run cost curve has been widely accepted. The long-run average cost curve or the economies-of-scale curve is given as an envelope curve which is tangent to the family of short-run average
cost curves. Any point on the economies-of-scale curve shows the least-cost combination of inputs required to produce a specified output. Generally we assume a U-shaped long-run average cost curve. The declining part of the long run average cost curve proves economies of scale, whereas the rising part of it determines diseconomies of scale. The long-run average cost curve or the economies-of-scale curve is also termed the long-run planning curve, because it shows the cost advantages, or disadvantages, for perspective firms of various sizes (Bressler 1945; Carter and Dean).

The empirical analysis of economies-of-scale can be categorized into three groups, according to the data used which determine the method, the scope, and the interpretation of the result: 1) analysis using Census data, 2) analysis using sampled cross section data, and 3) analysis using synthesized data.

Census data are sometimes used to show trends in the size distribution of firms and to pinpoint the most efficient firm size. This approach was originated by Stigler (1958) and is termed the Survivor Technique. This method assumes that, in the long-run, firm sizes which are efficient will survive and firm sizes which are inefficient will decline. Firms in the size class which show an increase in their relative output share in the industry are
presumed to be optimal. The survivor technique is appealing because it is simple and avoids statistical problems which might appear in cross-section analysis (Lund and Hill; Stanton). This method is supported by evidence of its usefulness in determining optimal scales, and in predicting impending changes in an industry (Saving; Weiss; Pasour). However, the survivor technique may not provide a valid indicator of the economies-of-scale because firms may survive for many reasons other than their internal efficiency (Bain). French suggests that environmental conditions pertaining to the extent of the market and the sources of raw materials are other factors which affect the firm's survival. In addition, since the profit-maximizing size may not, under the real life conditions, be at the lowest point of the long run average cost curve, one may expect firm operations to adjust toward sizes well beyond the most efficient size on the economies-of-scale curve (Lund and Hill; Madden and Partenheimer).

The average regression analysis has been widely used for sampled cross-section data. This approach has the advantage of estimating production and cost functions and testing theoretical hypotheses about them. However, even if we assume that there are no statistical problems such as sampling, aggregation, specification, and measurement,
regression analysis of economies-of-scale has several shortcomings. The regression line is an average or central tendency line which does not necessarily contain the tangent points with the envelope. As a least-squares regression is fitted to the cross-section data, the result is a curve that goes somewhere through the middle of the observed points (Walters). In addition, Bressler (1945, p. 528) states that:

Unfortunately, it combines and confuses cost changes that result from the more complete utilization of a plant of a given scale with the cost changes that accompany in scale. This is because sampled farms may be operating with non-optimum resource combinations. A related type of difficulty in the regression approach is referred to as the regression fallacy (Stigler 1952). Johnson (1964, p. 184) describes this:

... the regression fallacy is alleged to enter cross-section cost studies by transitional displacements in output with a disproportionate change in accounting costs so that an extreme observation of high output will show an unusually low per unit cost and conversely for an extremely low output observation.

Accordingly, the average line obtained from regression analysis is highly suspect and cannot be regarded as an estimate of the theoretical economies-of-scale curve.

Some attempts have been made to avoid the problem of regression fallacy. One attempt is to incorporate a measure
of capacity as a variable in the statistical analysis (Carter and Dean; Phillips). In this case, the capacity measure is commonly used as a shift variable. When this variable is set at 100, or full capacity, the estimated curve should correspond to the usual concept of the economies-of-scale curve, i.e., the envelope curve. The main problem with this analysis is the definition of capacity. A measured capacity may represent a bottleneck of some item of equipment, rather than a real capacity of the firm. Even without this difficulty, we may expect a joint relationship between costs and capacity and scale (Bressler 1945).

Another attempt is the estimation of the covariance cost function, combining both time-series and cross-section data (Johnson 1964). This approach may have an advantage of providing a test for the existence of the regression fallacy. It has also been argued that the covariance analysis reduces the risk of simultaneous equation bias in estimating the production or cost function (Hoch). While the covariance analysis can avoid the regression fallacy, it may produce a peculiar hybrid type of function that is difficult to interpret (French). Therefore, we have to note that each of the attempts explained still produces an average regression, but the things averaged may differ.
Alternatively, Bressler (1945) has suggested that instead of fitting regression functions, the long-run cost function might be estimated as an envelope curve to the bottom of the cost-volume scatter diagram when only cross-section data are available. Bressler (1945, p.529) insists that:

...it represents an attempt to define the locus of the lowest costs that were obtained at various volumes, and as such will approach the economy of scale curve in so far as the actual sample of plants included some which were efficiently organized and operated to capacity.

Thus the true envelope or the long-run average cost curve would more nearly correspond to the bottom edge of the scatter diagram (Madden and Partenheimer). When we use this approach, however, we need enough observations to include wide ranges of volumes, especially in large scale. Although a few studies applied this approach,¹¹ it has received considerable attention with respect to the production function. This is related to the so-called 'Frontier Production Function' which will be explained in detail when we discuss the relative economic efficiency.

As an alternative to the methods previously discussed, the economic-engineering approach utilizes synthesized data to estimate cost functions. Engineering, biological, or other detailed specifications of input-output relationships

¹¹ One example of this approach is seen in Ottoson and Epp.
are synthesized to develop short-run average cost curves, which in turn construct an envelope curve. This approach was initially suggested by Bressler (1945). The empirical application of this approach has mostly been conducted in experimental research stations (For example, Chan, Eeady, and Sonka; Johnston 1971; Matulich, Carmen, and Carter; Moore).

The economic-engineering approach avoids many of the problems encountered in statistical approaches. One may apply it to cases where accounting record data are not available. Once the basic information on the engineering, biological, or other input-output relationships has been obtained in one area, it can be useful in others. Likewise, as technical relationships, or technologies, change in some of the operations, it is relatively easy to utilize these changes in the total farm operations in order to determine the effects of these changes on the size or scale. In addition, the economic-engineering approach suggests what is possible in the farming operation, while statistical analysis using sampled data indicates what is being done (Faris; Faris and Armstrong).

The major limitation of the economic-engineering approach is that it requires high research cost. The technical details required to synthesize a cost function are
the main source of the high expenses. This approach also tends to omit some aspect of short-run cost as the size and complexity of the operation increases (Black). The economic-engineering approach has been criticized in that it is a kind of abstract analysis. This is because product and factor prices are assumed constant and technical coefficients are determined from selected sources such as experimental data, progressive farm data, etc. The economic-engineering approach has shown few findings of diseconomies of scale. This is attributable to the use of constant input coefficients and the inability to measure or account for coordination problems as firm scale increases. When synthetic estimates are obtained, they need to be checked against alternative sources of information, particularly actual performance of firm operations (French). Accordingly, the economic-engineering approach without the knowledge concerning the physical production function along with the existing price relationships may not provide an accurate synthesis of the cost function (Heady 1956; Olson).

So far, we have reviewed three general approaches for the analysis of economies-of-scale. Each has its own justification as well as limitations. However, the optimal choice will depend on the objectives of the study and the funds and data available.
3.1.2 Relative Economic Efficiency

Economic efficiency is the main concept which economists use to analyze the rationale of farm decision making. If farmers are inefficient in their management of resources, then agricultural production can be raised by simply improving the allocation of resources without having to develop new technology and absorbing additional resources (Farrell; Lau and Yotopoulos 1971; Pachico).

Economic efficiency has been used as a relative concept since it is almost impossible to set an absolute level of economic efficiency (Hall and Winsten; Pasour and Bullock). Economic efficiency can be split into technical efficiency and allocative (price) efficiency. Technical efficiency, as an engineering concept, is entirely abstract from the effect of price. Technical efficiency refers to whether firms obtain the maximum amount of output given the inputs in production. In terms of a relative efficiency, a firm is said to be more technically efficient than another if it consistently produces greater output from the same quantities of measurable inputs. Differences in technical efficiency are essentially differences in management factors, such as the technical knowledge, will, and effort. The major sources of technical inefficiency are related to technology, i.e., the complexity of technology and the rate
of change of the technology (Pachico). On the other hand, allocative or price efficiency is a behavioral concept. A firm is allocative-efficient if it maximizes profits by equating the value of marginal product of each variable input to its opportunity cost. Allocative inefficiency thus represents resource wastage.

The measurement of economic efficiency is an important problem for both the economic theorist and the economic policy maker. Several methodologies have been developed in order to measure relative economic efficiency. Perhaps the most common approach has been to compare the behavior of the best operating firms with the firms in question. Farrell developed an isoquant which is an envelope curve of the observations in the inputs and unit output space using linear programming. In drawing an envelope isoquant, there is no restraint except the shape of isoquant as a convex curve to the origin. Since the isoquant represents the most efficient performances among the observations, it is called a 'frontier production function'. This relationship can be illustrated for the two-inputs, one-output case as seen in Figure 3.1.

The unit isoquant UU' shows technical possibilities for efficient production, and any point on this isoquant can be termed technically efficient. In the Figure 3.1, for
Figure 3.1: The Unit Isoquant and the Measurement of Technical, Allocative, and Economic Efficiency
instance, points b and d represent the actual processes which are technically efficient. On the other hand, observation c is technically inefficient. Its technical efficiency is defined as the ratio of the distance between the origin to b and the distance between the origin to c, i.e., ob/oc. Points b and c represent the same factor proportions.

Allocative or price efficiency can be measured when input price level appears as an isocost line. While points b and d in Figure 3.1 are technically efficient, only observation d is allocative-efficient given the isocost line PP'. Point d assures the minimum cost in producing a unit of output. The allocative efficiency of point c is estimated by the ratio of the cost implied by the lowest possible isocost line to the cost at point b, i.e., oa/ob. Thus the measure of allocative efficiency is determined as the ratio of the minimum cost at the optimum factor proportion to the minimum cost given the factor proportion observed.

An estimate of overall, or economic efficiency, is the product of technical efficiency and allocative efficiency. Thus the economic efficiency of observation c is:

\[(ob/oc) (oa/ob) = oa/oc.\] This is the ratio of minimum production cost to actual observed cost.
Some problems are associated with Farrell's approach. The most prominent problem may be the reliance on outliers for the computation of the unit isoquant. For this, Farrell (pp. 260-261) states that:

... price efficiency is very sensitive to the introduction of new observations and to errors in estimating factor prices, so that it is likely to be rather unstable.

While Farrell has confidence in the measure of technical efficiency, Yotopoulos (p. 264) criticizes Farrell's approach saying that:

The difference in output between 'average' firm and the extreme positive outlier is used to measure the technical inefficiency of the average firm. Another interpretation, of course, could have the 'average' firm representing the norm and the positive outlier representing an unusual endowment of some fixed factor of production, such as entrepreneurship, or luck. It may represent the classical source of error in measurement or of noise in the universe, and as such it can imply nothing systematic about efficiency.

An alternative approach to estimating relative economic efficiency is a profit function model. This method depends on the theoretical duality between the production function and profit function. Nelson regards the exploitation of duality relations as an important recent methodological development in production function fitting. He points out the advantage of duality theory as it permits greater use of price data in estimating production relations.
Lau and Yotopoulos (1971) first applied the Unit-Output-Price (UOP) profit function to agricultural production. The profit function characterizes a firm's maximized profit as a function of the price of output, the prices of variable inputs, and quantities of the fixed inputs. They maintain that the profit function analysis is a method based on the precepts of economic theory, and is more general than the existing alternatives.¹² Lau and Yotopoulos (1971, p. 95) indicate the shortcomings of the alternative approaches by stating:

The deficiencies of the existing approaches to measuring efficiency should dictate the minimum requirements that a new concept of relative economic efficiency should meet if it is to be at all useful. (i) It should account for firms that produce different quantities of output from a given set of measured inputs of production. This is the component of differences in technical efficiency. (ii) It should take into account that different firms succeed to varying degrees in maximizing profits, i.e., in equating the value of the marginal product to each variable factor of production to its price. This is the component of price efficiency. (iii) The test should take into account that firms operate at different sets of market prices.

¹² The existing alternatives compared are as follows: partial productivity and total productivity indices for economic efficiency measurement; index of marginal product and opportunity cost for allocative efficiency estimation; and production function approach and Farrell's frontier function approach for technical efficiency measurement.
The profit function, however, requires good price data for inputs and outputs. The profit function approach will provide a reasonable test of relative economic efficiency only when this condition is met. Moreover, this methodology permits only the examination of relative efficiency between groups of firms.

3.1.3 **Economies-of-scale in Relation to Relative Economic Efficiency**

Since every point on the long-run average cost curve shows the optimal combination of inputs in each scale, the economic efficiency of an observation off the curve will be measured relative to the point on the envelope curve. If all observations lie on the economies-of-scale curve, then this curve itself measures relative economic efficiency.

When some observations are not on the envelope curve, the economic efficiency of such an observation is determined as follows. The observation will be first compared with the optimal point of the particular scale or size. This is the economic efficiency given scale (EES), which is a measure of the relative cost of production given scale. Then, the economic efficiency of the optimal point of the particular scale will be compared with the lowest point of the

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13 See Seitz for details on the technical efficiency and the allocative efficiency in relation with different scales.
economies-of-scale curve. This is the measurement of economic scale efficiency (ESE), i.e., an overall measure of the relative efficiency of alternative scale activities. The economic efficiency of an observation will finally be determined by the product of EES and ESE. Thus, the economic efficiency is a measure of the cost of production of each observation relative to the lowest cost observation. This relationship is illustrated in Figure 3.2.

LL' curve in Figure 3.2 is an envelope curve drawn in terms of index of average cost, and EE' curve shows the economic efficiency index of the envelope curve. The lowest point of LL' curve, c, corresponds to the highest economic efficiency. The economic efficiency of observation b is shown at point b', which is determined by the ratio of the index of average cost at c and the index of the average cost at b.

The implication of the relationship between the concepts of economies-of-scale and relative economic efficiency is that the economies-of-scale concept alone is not enough to explain the relationship between firm size and economic efficiency. While economies-of-scale shows the optimal level of input combination in every scale or size, relative economic efficiency compares real phenomena of firm operations on the average. Therefore both concepts are
Figure 3.2: Hypothetical Example of Relation of Relative Economic Efficiency to the Concept of Economies-of-Scale
required to analyze economic efficiency with respect to scale or size of firms.

3.2 TENANCY AND ALLOCATIVE EFFICIENCY

A debate on land tenure has long focused on the relationship between tenancy, especially sharecropping tenancy, and allocative efficiency. A large number of economists maintain that sharecropping tenancy results in an inefficient allocation of resources (Adams and Rask; Bardhan and Srinivasan 1971; Georgescu-Roegen; Ip and Stahl; Issawi; Shickele). Others argue that the form of land tenure has no necessary bearing upon allocative efficiency (Bray; Cheung 1968, 1969a, 1969b; Hendry; Huang; Reid 1975; Roumasset 1978, 1979; Ruttan).

The inefficiency argument (or disincentive proposition) is illustrated in Figure 3.3. In the figure, it is assumed, for simplicity, that agriculture operates in a world of certainty, and that the only inputs are land and labor. The disincentive argument is based on the fact that the sharecropper's labor is utilized at \( W_t \), where his marginal return, \((1-r)MVP\), is equal to his alternative wage, where \( r \) is the rate of share rental and \( MVP \) denotes the marginal value product of labor. On the other hand, fixed-rent tenancy and owner-farming are regarded as
Figure 3.3: Labor Input under Different Tenure Systems
equivalent, since they utilize resources up to the point where marginal value product equals its opportunity cost. Thus, it is concluded that sharecropping leads to an inefficient allocation of resources.

In contrast to the above argument, Cheung (1969a) has argued that sharecropping does not necessarily lead to allocative inefficiency. Cheung's reasoning is that under competitive conditions, private contracting between landlord and tenant would lead to the same resource allocation as if there had been competitive markets for labor and/or land. This argument has been supported by Reid (1976) and Roumasset (1978, 1979). In support of Cheung's proposition, Roumasset (1979) relies on a bargaining model which involves viable contractual arrangements, under the assumption that property rights are well-defined and contracting costs are zero. Roumasset does not suggest the possible outcomes of recontracting which make the recontracting parties better-off, while Currie formulates theoretical frameworks on the rearrangement of the rental agreement, which would lead the tenant to utilize his resource at N*, Figure 3.3, and make both the landlord and the tenant better-off. Examples of such a case, under the assumption of certainty and costless recontracting, are: (1) recontracting with a fixed absolute rental payment, (2)
recontracting for sharing costs as well as revenue, and (3) recontracting with stipulated levels of tenant's resource use under sharecropping. In this model, the bargaining power of the landlord or tenant will determine the magnitude of the gain obtained from the recontracting.

Although many recognize the importance of the bargaining power of both parties in determining the rate of rent and the allocative efficiency, little attention has been paid to the source of bargaining power and its relation to allocative efficiency under tenancy. From a practical standpoint it is difficult to justify the assumption of perfect competition and equal bargaining power in the rental market. On this matter, Ip and Stahl (p. 21) argue that:

Assuming perfect competition ipso facto implies that existing land tenure arrangements will be equally efficient. ...In view of this, one wonders why the debate has persisted along these lines.

This suggests that allocative efficiency is still a problematical issue in land tenure, particularly in the tenure systems in less developed countries where markets would be characterized by imperfections.

14 Details are presented in Appendix C.
Chapter IV

ANALYTICAL MODELS

This chapter contains explanation of the theoretical and methodological frameworks for analysis of relative economic efficiency between farm groups, economies-of-scale, and farm resource adjustments over time.

The profit function can be used to test relative economic efficiency which is subdivided into technical and allocative efficiency. The survivor technique and the scatter diagram approach are introduced as methods for investigating economies-of-scale. Finally the distributed lag model is discussed in connection with the farm input adjustment process.

4.1 PROFIT FUNCTION MODEL FOR RELATIVE ECONOMIC EFFICIENCY MEASUREMENT

The profit function model has been widely adopted for efficiency analyses since Lau and Yotopoulos (1971) used it to analyze Indian agriculture. Using the profit function model, we can analyze economic efficiency in terms of technical efficiency and allocative or price efficiency. The relationship of the concepts of technical, allocative, and economic efficiency are explained below.
Assuming the production functions for two firms are given by:

\[ \begin{align*}
V_1 &= A_1 F(X_1, Z_1); \\
V_2 &= A_2 F(X_2, Z_2)
\end{align*} \]

where superscripts identify firms, \( A \) is the technical term, \( X \) indicates the vector of variable inputs, and \( Z \) the vector of fixed inputs. If the two firms are equally technically efficient, then \( A_1 \) equals \( A_2 \). If they differ, then the difference can be explained by differences in environmental factors, in managerial ability, and in nonmeasurable fixed factors of production.

The marginal conditions for profit maximization are given by:

\[ \begin{align*}
\frac{\partial A_1 F(X_1, Z_1)}{\partial x_{1j}} &= k_j c_{1j}; \\
\frac{\partial A_2 F(X_2, Z_2)}{\partial x_{2j}} &= k_j c_{2j} \quad k_j > 0, \quad j = 1, \ldots, m
\end{align*} \]

where \( c_j \) denotes an opportunity cost of input \( j \) and \( k_j \) is an adjusting factor for equality between marginal product of factor \( j \) and \( c_j \). If a firm is perfectly successful in equalizing the marginal product of input \( j \) to its price, then \( k_j \) assumes value of one for that specific input. If, and only if, two firms are equally allocative-efficient with respect to all variable inputs, then \( k_j^1 = k_j^2 \), \( j = 1, \ldots, m \).
The null hypothesis of equal relative economic efficiency for firm 1 and 2 implies that $A_1 = A_2$ and $k_j^1 = k_j^2$, $j=1, \ldots, m$.

The above relationships between two firms can be formulated in the profit function. With the production function $V = AF(X,Z)$, we may obtain a nominal profit, which is defined as current total revenue less current total variable costs,

$$\text{(4.3)} \quad \pi' = p \cdot AF(X,Z) - \sum_{j=1}^{m} c_j^1 X_j$$

where $\pi'$ is profit, $p$ is the unit price of output, and $c_j^1$ is the unit price of the $j$th variable input. Dividing both sides by $p$, we get

$$\text{(4.4)} \quad \pi = \frac{\pi'}{p} = AF(X,Z) - \sum_{j=1}^{m} c_j X_j$$

where $\pi$ is defined as the "Unit-Output-Price" (UOP) profit and $c_j = c_j^1/p$, which is defined as the normalized price of the $j$th input. When the UOP profit is maximized by satisfying the marginal conditions for variable inputs, the UOP profit is written as:

$$\text{(4.5)} \quad \pi^* = AF(X^*,Z) - \sum_{j=1}^{m} c_j X^*_j$$
By a well-known theorem proved by McFadden, the above UOP profit function can be expressed as (Lau and Yotopoulos 1971; Lau 1978):

\[(4.6) \quad \pi^* = AG^*(c/A, Z)\]

Thus, the actual UOP profit functions of the two firms will be

\[(4.7) \quad \pi^i = A^iG^*(k^i_1c^i_1/A^i, \ldots, k^i_mc^i_m/A^i; Z^i_1, \ldots, Z^i_n) \quad i=1,2.\]

On the basis of a priori theoretical context, the UOP profit function is decreasing and convex in the normalized prices of variable inputs and increasing in quantities of fixed inputs.

In the expression of dual transformation, the derived demand functions for variable inputs are given by the Shephard-Uzawa-McFadden lemma. The derived demand function is given by:

\[(4.8) \quad x^*_j = - \frac{\partial \pi^i}{\partial k^i_jc^i_j} = -A^i\frac{\partial G^*}{\partial k^i_jc^i_j} = -A^i \cdot \frac{\partial G^*}{\partial c^i_j}, \quad i=1,2; \quad j=1,\ldots,m.\]

The lemma also gives the supply function,

---

15 For determining \(x^*_j\), we use the marginal condition

\[\frac{\partial \pi}{\partial x^*_j} = A \frac{\partial F(X,Z)}{\partial x^*_j} = c_j. \quad \text{Then} \quad \frac{\partial F(X,Z)}{\partial x^*_j} = \frac{c_j}{A}.\]

This equation may be solved for the optimal quantities of variable inputs, \(x^*_j\), as a function of the normalized price of the variable inputs and of the quantities of the fixed inputs: that is \(x^*_j = f_j(c/A, Z), \quad j=1,\ldots,m.\)
Using equations (4.8) and (4.9), we may rewrite the UOP profit function as:

\[(4.10) \; \pi^i = v^i - \sum_{j=1}^{m} \frac{\partial}{\partial c_j} c_j = A^i G^* - A^i \sum_{j=1}^{m} \frac{\partial G^*}{\partial c_j} c_j^i, \; i=1,2.\]

To the above equation, we now proceed to specify the appropriate functional form and formulate operational basis for an empirical test of relative economic efficiency. A Cobb-Douglas production function with \(m\) variable inputs and \(n\) fixed inputs is given by:

\[(4.11) \; V = A \left( \prod_{j=1}^{m} X_j \right) \left( \prod_{q=1}^{n} Z_q \right)\]

The corresponding UOP profit function is given by:\[16\]

\[(4.12) \; \pi^* = A^{(1-\mu)} \left( \prod_{j=1}^{m} (c_j/\alpha_j) \right) \left( \prod_{q=1}^{n} Z_q \right) \left( \sum_{j=1}^{m} \frac{\beta_q (1-\mu)}{-\alpha_j (1-\mu)} \right)\]

where \(\mu = \sum_{j=1}^{m} \alpha_j < 1.\]

\[16\] Refer to Lau (1978) for details about the derivation of the UOP profit function from the production function.
If we substitute $k_j c_j$ for $c_j$ in equation (4.12), then the actual UOP profit function for each firm becomes

\[ \pi_i^j = (A_i)^{(1-\mu)^{-1}} (1-\mu) \left( \prod_{j=1}^{m} \frac{-\alpha_j (1-\mu)^{-1}}{(k_j^i c_j^i / a_j^i)} \right) \left( \prod_{q=1}^{n} \frac{\beta_q (1-\mu)^{-1}}{z_q^i} \right) \]

\[ i = 1, 2. \]

By direct computation using equations (4.8) and (4.10), the actual UOP profit functions and the derived demand functions are given in equations (4.14) and (4.15):

\[ \pi_i^j = (A_i)^{(1-\mu)^{-1}} (1-\mu) \left( \prod_{j=1}^{m} \frac{-\alpha_j (1-\mu)^{-1}}{(k_j^i)} \right) \left( \prod_{q=1}^{n} \frac{\beta_q (1-\mu)^{-1}}{z_q^i} \right) \]

\[ i = 1, 2. \]

\[ X_i^j = (A_i)^{(1-\mu)^{-1}} (\alpha_j / k_j^i c_j^i) \left( \prod_{j=1}^{m} \frac{\alpha_j (1-\mu)^{-1}}{(k_j^i)} \right) \left( \prod_{q=1}^{n} \frac{\beta_q (1-\mu)^{-1}}{z_q^i} \right) \]

\[ i = 1, 2; j = 1, \ldots, m. \]

Equations (4.14) and (4.15) can be written as:

\[ \pi_i^j = A_i \prod_{j=1}^{m} (c_j^i)^{\alpha_j^*} \prod_{q=1}^{n} (z_q^i)^{\beta_q^*} \]
(4.15)' \( x_j^1 = \frac{A^*_j c_j^1 \sum_{j=1}^m a_j^1 c_j^1}{\prod_{q=1}^n (z_q^1)^{\beta^*_q}} \)

where

\[
A^*_j \equiv (A^2)^{(1-\mu)^{-1}} \left(1 - \sum_{j=1}^m \frac{\alpha_j}{k_j^1} \right) \left( \prod_{j=1}^m (k_j^1)^{-\alpha_j(1-\mu)^{-1}} \right) \left( \prod_{j=1}^m (\alpha_j)^{1-\mu} \right)
\]

\[\alpha^*_j \equiv \alpha_j(1-\mu)^{-1}\]

\[\beta^*_q \equiv \beta_q(1-\mu)^{-1}\]

\[k^*_j \equiv (1 - \sum_{j=1}^m \frac{\alpha_j}{k_j^1}) (1-\mu)^{-1}\]

From equation (4.14)', we may theoretically compare the economic efficiency of the two firms. By writing \(A^1_\alpha\) and \(A^2_\alpha\) for firm 1 and firm 2, respectively, and taking the ratio of constant terms, we have

\[
(4.16) \frac{A^2_\alpha}{A^1_\alpha} = \frac{A^2 (1-\mu)^{-1}}{A^1} \frac{(1 - \sum_{j=1}^m \frac{\alpha_j}{k_j^1}) (1-\mu)^{-1}}{(1 - \sum_{j=1}^m \frac{\alpha_j}{k_j^1}) (1-\mu)^{-1}}
\]

We note that if \(A^1 = A^2\) and \(k^1_j = k^2_j\), then \(A^1_\alpha = A^2_\alpha\) and the two firms have identical profit functions, which means that the two firms are equally economic-efficient.
The derived demand functions for variable inputs are given by:

\[(4.17) \quad x_j^* = -\frac{\partial \pi^*}{\partial c_j} \quad j = 1, \ldots, m.\]

Multiplying both sides of equation \((4.17)\) by \(-c_j/\pi^*\), we get

\[(4.18) \quad -\frac{c_jx_j^*}{\pi^*} = \frac{\partial \ln \pi^*}{\partial \ln c_j} \quad j = 1, \ldots, m.\]

For the Cobb-Douglas profit function, it becomes

\[(4.19) \quad -\frac{c_jx_j^*}{\pi} = a_j^* \quad j = 1, \ldots, m.\]

Applying this relationship and using the equations \((4.14)'\) and \((4.15)'\), we have

\[(4.20) \quad -\frac{c_j^ix_j^i}{\pi^i} = (k_j^i)^{-1} (k_x^i)^{-1} a_j^* = a_j^* \quad i=1,2; j=1, \ldots, m.\]

From equation \((4.20)\), we may obtain two implications for relative efficiency tests: (1) if \(a_j^* = a_j^*\), then \(k_j^i = 1.0\) and firm \(i\) satisfies the marginal condition for profit maximization in terms of utilizing input \(x_j\). This is the absolute allocative or price efficiency; and (2) if \(a_j^{i1}=a_j^{i2}\), then the two firms are equally allocative-efficient with respect to the use of input \(x_j\). This is the criterion for the test of relative allocative efficiency.
Taking a natural logarithm to equation (4.14) and using equation (4.20), we get a Cobb-Douglas type actual UOP profit function model which is given by

\[ \ln \pi = \ln A + \sum_{i=1}^{m} \alpha_i \ln c_i + \sum_{j=1}^{n} \beta_j \ln Z_j \]  
(4.21)

\[ \frac{c_i X_i}{\pi} = \alpha_i' \quad i = 1, ..., m. \]  
(4.22)

where \( \pi \) denotes the normalized profit, \( c_i \) the normalized price of variable input, and \( Z_j \) the fixed input all in physical unit.

To compare relative economic efficiency between two groups of farms, we may specify the UOP profit function model as

\[ \ln \pi = \ln A + e D_2 + \sum_{i=1}^{m} \alpha_i \ln c_i + \sum_{j=1}^{n} \beta_j \ln Z_j \]  
(4.23)

\[ \frac{c_i X_i}{\pi} = \alpha_{i1} D_1 + \alpha_{i2} D_2 \quad i = 1, ..., m. \]  
(4.24)

where \( D_k \) denotes dummy variable for each farm group and \( \alpha_{ik} \) identifies each group's \( \alpha_i' \) coefficient (\( k = 1, 2 \)).

Estimating the above equations jointly, we can test the following hypotheses:

1. Equal relative economic efficiency:
   \[ \text{Ho: } e = 0. \]

2. Equal relative allocative efficiency:
   \[ \text{Ho: } \alpha_{i1} = \alpha_{i2} \quad i = 1, ..., m. \]

3. Equal technical and allocative efficiency.
This hypothesis is necessary because it is possible for two farm groups to be equally economic-efficient without being equally technical-efficient or equally allocative-efficient or both:

\[ H_0: e = 0, \alpha_{i1} = \alpha_{i2} \quad i = 1, \ldots, m. \]

4. Absolute allocative efficiency of each farm group. This is to test whether each farm group maximizes its profit:

\[ H_0: \alpha_i = \alpha_{ik} \quad i = 1, \ldots, m; \quad k = 1, 2. \]

5. Constant returns to scale:

\[ H_0: \frac{\sum_j \beta_j}{n} = 1.0. \]

4.2 **SURVIVOR TECHNIQUE AND SCATTER DIAGRAM APPROACH FOR THE ECONOMIES-OF-SCALE ANALYSIS**

The empirical analysis of the economies-of-scale is not an easy task to conduct. In this study, the existence of economies or diseconomies of scale will be investigated by the methods of the Survivor Technique and the Scatter Diagram. Since no single method is completely satisfactory for analysis of economies-of-scale, these two approaches are believed to provide more general evidence of economies or diseconomies of scale than any one particular method.
4.2.1 The Survivor Technique

The purpose of the survivor technique is to find the optimal firm size class by examining the trend of changes in number of firms in each size class or relative share of output in the class over selected time intervals. If a firm size class shows an increasing trend in the relative proportion in the number of firms in an industry over some time intervals, then that firm size will be identified as the best surviving and, thus, defined as optimal.

The survivor technique is based on Stigler's proposition that the class of firm size surviving best would have minimal average production costs. Although the survivor technique faces shortcomings, it is supported by some evidences suggested in the previous chapter. The survivor technique is a simple and indirect method of determining economies of scale (Lund and Hill; Stanton).

The variables which will be considered in this study include the relative distribution of farm numbers among different farm size classes, and the average production cost per unit of output among different size classes.
4.2.2 The Scatter Diagram Approach

The scatter diagram approach, which was suggested by Bressler (1945), will provide an envelope curve along the locus of the lowest points in a cost-volume scatter diagram. Theoretically, the economies-of-scale curve traces the minimum cost of producing each level of output. Thus, the envelope curve obtained from the scatter diagram will closely represent the long-run average cost curve. As Stollsteimer, Bressler, and Boles argue, graphic analysis will give the researcher a "feeling" for his data and facilitate the use of the envelope or near-envelope curve rather than an average regression line.

4.3 DISTRIBUTED LAG MODEL

The necessary condition for the optimal allocation of the i th input will be met when marginal value product of the input equals its price, i.e.,

$$\frac{\partial V}{\partial X_i} = \frac{p_i}{P}$$

(4.25)

where \(V\) is production function, \(X_i\) is the i th input, \(p_i\) is the price of the i th input, and \(P\) is the output price. This constitutes a partial equilibrium. Multiplying both sides of the above equation by \(X_i/V\), we get

$$\frac{\partial V}{\partial X_i} \frac{X_i}{V} = \frac{p_i X_i}{P V}$$

(4.26)
At equilibrium, the production elasticity of ith input equals its factor share. Thus, if it is assumed that production is at equilibrium, then factor share can be used as proxy value for production elasticity. However, the assumption that economic equilibrium is always attained is dubious (Tyner and Tweeten 1965). We need, rather, the alternative assumption that the employment of a factor (expenditure on the factor) tends to be adjusted towards an equilibrium level. This suggests a distributed lag model as defined below:

\[(4.27) \; F(t) - F(t-1) = \lambda (E^*(t) - F(t-1)) \]

where \(E^*(t)\) denotes the current equilibrium factor share, \(\lambda\) the proportion of adjustment to the equilibrium made in one time period, and \(F(t)\) the factor share of year t. Here the character i identifying each input is dropped for a simpler expression of the model.

Griliches has shown the basic rationale of an adjustment model like equation (4.27). The model premises that there exist some costs of adjustment such as: (1) the cost of being out of equilibrium; and (2) the adjustment cost. If both types are quadratic, we can write the firm's overall cost function as

\[(4.28) \; C(t) = a(F(t) - E^*(t))^2 + b(F(t) - F(t-1))^2 \]
where \( a \) is the unit cost of being cut of equilibrium, and \( b \) is the unit cost of adjustment. The problem is to choose \( F(t) \), given \( F(t-1) \) and \( E^*(t) \), to minimize \( C(t) \). Thus,

\[
\frac{\partial C(t)}{\partial F(t)} = 2a(F(t) - E^*(t)) + 2b(F(t) - F(t-1))
\]

giving

\[
(4.29) \quad F(t) = \frac{a}{a+b} E^*(t) + \frac{b}{a+b} F(t-1)
\]

or

\[
(4.30) \quad F(t) - F(t-1) = \frac{a}{a+b} (E^*(t) - F(t-1)).
\]

The adjustment coefficient, \( \lambda \), becomes \( a/(a+b) \). Only in the case of zero adjustment cost \( b=0 \), the \( \lambda \) would be 1.0. As the adjustment cost tends to be higher, the rate of adjustment would be slower.

Using the above model, we can obtain adjustment coefficient and optimal factor share. These estimates will be used to compare the resource adjustment processes among different farm size classes. The magnitude of the adjustment coefficient indicates how flexible farmers are in reallocating their resources toward new equilibrium conditions.
Chapter V

FARM SIZE AND ECONOMIC EFFICIENCY

In this chapter we examine the relationship between farm size and economic efficiency, and the dynamic adjustments in resource use over time.

Economic efficiency of farm size classes is analyzed using three methods -- the profit function model, the survivor technique, and the scatter diagram of unit cost and output. The profit function model is used to test hypotheses of the relative economic efficiency among farm size classes, while the survivor technique and the scatter diagram approach are employed to analyze the extent of economies-of-scale. For the analysis of resource use adjustment over time, a partial adjustment analysis is carried out with a distributed lag model. In addition, to further evaluate the above analyses, an examination of the expected economic efficiency level beyond the farm size barrier, and the agricultural income levels at various farm sizes, was conducted.
5.1 **RELATIVE ECONOMIC EFFICIENCY**

This section discusses the estimation of the profit function and the hypotheses tests which are related to the relative economic efficiency among different farm size classes. Farms are ranked into four size classes according to total cultivated land area, as shown in Table 5.1, and defined below.

5.1.1 **Data and Farm Size Definition**

Data used for this analysis were drawn from a 1977 cross-section farm survey of rice production costs conducted by the Korean Ministry of Agriculture & Fisheries. The original data were collected by the daily logs, in which the farmer of the selected farms recorded every day's management activity. A total 3,375 farms were selected for this survey.

From the original data, farms in which rice production was the main productive activity or major income source were identified. Thus, farms were selected if their paddy land area was greater than 50 percent of the total cultivated land, and if the value of rice produced was larger than 50 percent of the value of total farm output. In addition, only owner-operators were considered for this analysis of relative economic efficiency. This was done to eliminate
the possible influence of the tenancy system when comparing economic efficiency among different farm size classes. A total of 933 farms were selected for the estimation of the UOP profit function.

Farm size can be measured in several ways. In this study, farm size was measured by the entire land area operated by a farm. This method has been widely used in Korea; and agricultural statistics are published using this definition when they are separated according to farm size. Four farm size classifications were outlined.

a) Small farms: farms cultivating less than 1 hectare of farm land.

b) Medium farms: farms cultivating land area from 1 hectare to 2 hectares.

c) Large farms: farms cultivating land area from 2 hectares to 3 hectares.

d) Extra-large farms: farms cultivating more than 3 hectares of farm land.

17 We will analyze the allocative efficiency of tenant-operated farms in the next chapter.
TABLE 5.1
Selected Owner-Farms by Farm Size

<table>
<thead>
<tr>
<th>Farm Size</th>
<th>Number of Farms</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 ha</td>
<td>530</td>
<td>56.8</td>
</tr>
<tr>
<td>1 - 2 ha</td>
<td>306</td>
<td>32.8</td>
</tr>
<tr>
<td>2 - 3 ha</td>
<td>67</td>
<td>7.2</td>
</tr>
<tr>
<td>Over 3 ha</td>
<td>30</td>
<td>3.2</td>
</tr>
<tr>
<td>Total</td>
<td>933</td>
<td>100.0</td>
</tr>
</tbody>
</table>

5.1.2 Model Specification

The equations estimating the UOP profit function and the variable input demand function are specified below:

\[
(5.1) \ln \pi = \ln A + e2 d2 + e3 d3 + e4 d4
+ \alpha \ln w + \beta_1 \ln L + \beta_2 \ln FN + \beta_3 \ln K
\]

\[
(5.2) \frac{w \cdot \text{HN}}{\pi} = \alpha_1 d1 + \alpha_2 d2 + \alpha_3 d3 + \alpha_4 d4
\]

where \( \pi = \) UOP profit in Korean Won. Nominal profit is calculated by subtracting hired wage bill from total revenue. Then the UOP profit is obtained by dividing the nominal
profit by unit-output price.\(^\text{18}\)

d_1 = \text{dummy variable: 1 for small farms; 0 otherwise.}

d_2 = \text{dummy variable: 1 for medium farms; 0 otherwise.}

d_3 = \text{dummy variable: 1 for large farms; 0 otherwise.}

d_4 = \text{dummy variable: 1 for extra-large farms; 0 otherwise.}

w = \text{the hourly wage rate of hired labor (man-equivalent) divided by unit-output price.}

L = \text{the physical paddy land units measured as pyung.}\(^\text{19}\)

FN = \text{the man-equivalent family labor input in hours.}

K = \text{the imputed capital interests in Korean Won for the fixed and flow capital used in producing rice.}

HN = \text{the man-equivalent hired labor input in hours.}

In this analysis, hired labor is regarded as a variable input. Many other studies have treated family labor as a variable input. However, the case of Korean family farms seems different because of the serious labor shortages in

\(^{18}\) The unit-output-price is obtained by dividing total revenue by total physical output. The unit-output-price is measured in Korean Won per kilogram of produced rice.

\(^{19}\) A 3,000 pyung is almost equivalent to 1 hectare which is about 2.5 acres.
rural areas. Family labor should be fully utilized regardless of its opportunity cost. This would be particularly applicable as long as farmers try to maximize short-run profits. Labor supplied above the family labor contribution, hired labor, can be regarded as a variable input. Thus, labor is divided into hired labor as a variable input and family labor as a fixed input.

In the above profit function, wage rate is specified as a price variable for hired labor. There are other variable inputs such as fertilizers and pesticides. However, their prices are not specified as price variables in the profit function because the prices of fertilizers and other chemicals are mostly controlled by government and uniform to every farm in Korea. Thus, these variables are indirectly included in capital variable, \( K \). Fixed inputs specified include land, capital, and family labor.

5.1.3 Estimation and Hypotheses Test

The estimating equation (5.1) includes different intercepts for each farm size class. Slopes for each farm size class are assumed to be equal. This means the four farm size classes have the same profit function except for the constant terms. Prior to estimating this equation, a hypothesis of equal slopes of the profit function should be
tested for the different farm size classes. If the null hypothesis of equal slope cannot be rejected, an estimate of the UCP profit function can be made based on equation (5.1). However, rejection of the null hypothesis requires separate specification of equations for each farm class. Direct comparison of economic efficiency between farm size classes is not possible with the equations estimated separately. This hypothesis was tested by covariance analysis.\textsuperscript{20} The computed $F$-statistic from the covariance analysis was 1.16 with $(22,913)$ degrees of freedom, which is less than a critical $F$-value at the five percent of significance level, i.e., $F(22,913) = 1.52$. Thus, the null hypothesis of equal slopes for every farm size class cannot be rejected.

The analysis indicates that the four farm size classes have the same profit function except for intercepts, which also means that they have the same production function.

\textsuperscript{20} For the test of the hypothesis, we first estimate UCP profit function separately for each farm size class. Let the residual sum of squares of each equation be $r(i)'r(i)$, $i=1,2,3,4$. Then we calculate

$$r'r = r(1)'r(1) + r(2)'r(2) + r(3)'r(3) + r(4)'r(4).$$

Next we pool the data and estimate a UCP profit function with different intercepts using dummy variables. In this case, slopes are restricted to be the same for every class. Let $e'e$ be the residual sum of squares of the pooled equation. Then we calculate the $F$-statistic for testing the hypothesis of equal slopes: i.e.,

$$F = (e'e - r'r)/(pk - p - k + 1))/(r'r/(n - pk)),$$

where $p =$ number of classes, $k =$ number of independent variables including intercept, and $n =$ total observations.
except for technical efficiency terms. However, this does not mean that they have equal allocative efficiency.

Allocative efficiency will be determined by the joint estimation of the UOP profit function and the factor demand function. Equation (5.1) and equation (5.2) were estimated jointly using Zellner's seemingly unrelated regression method (Zellner). The result of the estimation is given in Table 5.2.

In general, the signs of the estimated coefficients are consistent with the theoretical properties of the profit function, except the coefficient for family labor. It seems that the negative sign for the family labor comes from the process of joint estimation of the profit function and the hired labor demand function. When the profit function is estimated by the ordinary least squares method, the parameter of the family labor is positive and significant. Due to the correlation across models, the parameter turns out to be negative while the two models are being systematically estimated by the seemingly unrelated regression method. However, it is unlikely that the parameter for family labor influences the hypotheses tests of relative economic efficiency. The coefficient of family labor is negative, but statistically insignificant. The

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21 Seemingly unrelated equation model is conceptually explained in Appendix B.
### TABLE 5.2
Joint Estimation of UOP Profit Function and Factor Demand Function for Owner Farmers in Rice Production, 1977

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Estimated Coefficients</th>
<th>Hired Labor Demand Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln A</td>
<td>0.2348 a (1.5703)</td>
<td>$a_1$</td>
</tr>
<tr>
<td>$e_2$</td>
<td>0.0429 (1.8067)</td>
<td>$a_2$</td>
</tr>
<tr>
<td>$e_3$</td>
<td>0.0079 (0.1932)</td>
<td>$a_3$</td>
</tr>
<tr>
<td>$e_4$</td>
<td>-0.0108 (-0.1860)</td>
<td>$a_4$</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>-0.0652 (-1.9501)</td>
<td></td>
</tr>
<tr>
<td>$\beta_1$</td>
<td>0.9258 (35.6120)</td>
<td></td>
</tr>
<tr>
<td>$\beta_2$</td>
<td>-0.0077 (-0.6964)</td>
<td></td>
</tr>
<tr>
<td>$\beta_3$</td>
<td>0.1039 (5.1305)</td>
<td></td>
</tr>
</tbody>
</table>

weighted $R^2$ for system: 0.8533

Note: Numbers in parentheses are asymptotic t-ratios.
coefficients of the dummy variables and those in the demand function will be explained when they are used in testing statistical hypotheses.

In carrying out statistical tests, the following null hypotheses were formed.

1. The hypothesis of equal relative economic efficiency between small farms and other farm size classes: i.e.,
   \[ H_0: e_2 = 0 \text{ or } e_3 = 0 \text{ or } e_4 = 0 \]

2. The hypothesis of equal allocative efficiency with respect to hired labor input: i.e.,
   \[ H_0: \alpha_i = \alpha_j \quad i \neq j \]
   \[ i = 1, 2, 3, 4 \]
   \[ j = 1, 2, 3, 4 \]

3. The joint hypothesis of equal relative technical and allocative efficiency between small farms and other farm classes. This hypothesis is to check if the two farm classes are equally economic-efficient without being equally technical-efficient or equally allocative-efficient or both: i.e.,
   \[ H_0: e_i = 0 \text{ and } \alpha_i = \alpha_1 \]
   \[ i = 2, 3, 4 \]

4. The hypothesis of absolute allocative efficiency with respect to hired labor input: i.e.,
   \[ H_0: \alpha_j = \alpha \quad , j = 1, 2, 3, 4 \]
5. The hypothesis of constant returns to scale: i.e.,

$$H_0: \beta_1 + \beta_2 + \beta_3 = 1.0$$

The results of these hypotheses tests are reported in Table 5.3.

5.1.3.1 Equal Relative Economic Efficiency Test

Since economic efficiency is defined as the combination of technical and allocative efficiency, the implication of the relative economic efficiency test is of significance. If one class is economically more efficient than other class, then its economic achievement is higher. The level of success in production and business activity is compared using relative economic efficiency test.

Using the estimated profit function, relative economic efficiency can only be tested between small farm size class and other farm size classes. Thus direct comparison of economic efficiency between medium farms and large farms or between large farms and extra-large farms is not possible. However, from the comparison of small farms and other farms, we may infer the relative economic efficiency between other farm size classes including medium, large, and extra-large farm size classes.

The statistical hypothesis of equal relative economic efficiency between the small farm size class and medium farm
<table>
<thead>
<tr>
<th>Hypotheses Tested</th>
<th>Computed F-ratio and Degrees of Freedom</th>
<th>Result of the Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Equal Relative Economic Efficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) $e_2 = 0$</td>
<td>$3.32(1,1854)$</td>
<td>Rejected at 10%</td>
</tr>
<tr>
<td>(2) $e_3 = 0$</td>
<td>$0.04(1,1854)$</td>
<td>Maintained</td>
</tr>
<tr>
<td>(3) $e_4 = 0$</td>
<td>$0.04(1,1854)$</td>
<td>Maintained</td>
</tr>
<tr>
<td>II. Equal Relative Allocative Efficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4) $a_1 = a_2$</td>
<td>$0.06(1,1854)$</td>
<td>Maintained</td>
</tr>
<tr>
<td>(5) $a_1 = a_3$</td>
<td>$7.29(1,1854)$</td>
<td>Rejected at 5%</td>
</tr>
<tr>
<td>(6) $a_1 = a_4$</td>
<td>$6.28(1,1854)$</td>
<td>Rejected at 5%</td>
</tr>
<tr>
<td>(7) $a_2 = a_3$</td>
<td>$7.45(1,1854)$</td>
<td>Rejected at 5%</td>
</tr>
<tr>
<td>(8) $a_2 = a_4$</td>
<td>$6.51(1,1854)$</td>
<td>Rejected at 5%</td>
</tr>
<tr>
<td>(9) $a_3 = a_4$</td>
<td>$0.30(1,1854)$</td>
<td>Maintained</td>
</tr>
<tr>
<td>III. Equal Relative Technical and Allocative Efficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(10) $e_3 = 0$, $a_1 = a_3$</td>
<td>$3.89(2,1854)$</td>
<td>Rejected at 5%</td>
</tr>
<tr>
<td>(11) $e_4 = 0$, $a_1 = a_4$</td>
<td>$3.18(2,1854)$</td>
<td>Rejected at 5%</td>
</tr>
<tr>
<td>IV. Absolute Allocative Efficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(12) $a_1 = \alpha$</td>
<td>$0.03(1,1854)$</td>
<td>Maintained</td>
</tr>
<tr>
<td>(13) $a_2 = \alpha$</td>
<td>$0.05(1,1854)$</td>
<td>Maintained</td>
</tr>
<tr>
<td>(14) $a_3 = \alpha$</td>
<td>$0.15(1,1854)$</td>
<td>Maintained</td>
</tr>
<tr>
<td>(15) $a_4 = \alpha$</td>
<td>$0.33(1,1854)$</td>
<td>Maintained</td>
</tr>
<tr>
<td>V. Constant Return to Scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(16) $\beta_1 + \beta_2 + \beta_3 = 1.0$</td>
<td>$1.25(1,1854)$</td>
<td>Maintained</td>
</tr>
</tbody>
</table>
size class is rejected at the 10 percent significance level (Table 5.3). However, the economic efficiencies of large farms and extra-large farms are not significantly different from that of small farms. Thus the medium farm size class appears to be the most successful class among the four farm size classes in producing rice. The result, however, does not reveal whether the higher relative economic efficiency comes from technical efficiency, or from allocative efficiency, or from both. A further test of hypotheses on relative allocative efficiency and absolute allocative efficiency is required.

5.1.3.2 Equal Relative Allocative Efficiency Test

The relative allocative efficiency test examines the similarity of resource allocation between different farm size classes. Whether their resources are allocated at optimum levels is not a matter of concern in this test. Even though two farm classes do not optimally utilize variable resources, allocative efficiencies may appear equal.

The hypotheses tests show that small farms and medium farms have equal relative allocative efficiency, and that large farms and extra-large farms also have equal relative allocative efficiency. But, the small and medium farms, as
a group, and the large and extra-large farms, as another group, are significantly different in relative allocative efficiency. This result does not, however, indicate whether or not each farm size class utilizes hired labor at the optimum level for profit maximization.

5.1.3.3 Joint Test of Equal Relative Technical and Allocative Efficiency

When two farm classes show equal relative economic efficiency, a joint hypothesis of equal relative technical and allocative efficiency must be tested. Even though two farm classes are equally economic-efficient, they may differ in technical efficiency, allocative efficiency, or both.

In this study, large farms and extra-large farms appear to be equally as economically efficient as small farms. The joint hypothesis, however, does not seem necessary because differences have been shown in the allocative efficiency between small farms and large farms, and between small farms and extra-large farms. As expected, the joint hypotheses are rejected at the five percent level of significance. This implies that differences in technical efficiency compensate for differences in allocative efficiency to result in equal relative economic efficiency.
5.1.3.4 Absolute Allocative Efficiency Test

The test of absolute allocative efficiency hypothesis in this study is to check if farms in each size class equate marginal value product of hired labor to opportunity cost measured in terms of wage rate. The null hypotheses are not rejected at the five percent significance level in all classes. These results may conflict with the results of the relative allocative efficiency tests. From these results, we may infer that large and extra-large farms differ relatively in allocating their hired labor from small farms, but their allocation of hired labor is not significantly different from the optimal condition for profit maximization. Moreover, if we give more weight to the results of the absolute allocative efficiency test than to the results of the relative allocative efficiency test, we cannot conclude that the four farm size classes are different in allocative efficiency with respect to hired labor input.²²

²² Note that the ultimate criterion on allocative efficiency is set by the profit maximization condition which is an initiating point in deriving a dual relation of profit function from production function.
5.1.3.5 Constant Returns to Scale Test

The null hypothesis of constant returns to scale is not rejected at the five percent level of significance. This result leaves open the possibility that constant returns to scale may exist in Korean rice farming. However, drawing a firm conclusion about the nature of scale economies in Korean rice farming is not advisable at this point and further investigation follows. Our statistical analysis thus far still does not provide sufficient evidence of the real nature of scale economies.\textsuperscript{23}

5.1.4 Summary

Based on the joint estimation of the UCP profit function and the hired labor demand function, we were able to test hypotheses on the relative economic efficiencies of the four farm size classes considered in this study. The results of the tests indicate that, in 1977, medium sized farms cultivating between 1 to 2 hectares were economically more efficient than other farms in producing rice. Compared with small farms, the higher economic efficiency of medium farms was due to a higher technical efficiency by default since the hypothesis of equal relative allocative efficiency

\textsuperscript{23} As discussed in the review of literature chapter, this is related to the argument on the disadvantage of using regression analysis in estimating a long-run average cost curve.
between the two farm classes was maintained. Large and extra-large farms appeared to be equally as economically efficient as small farms. All farm classes showed that they were able to satisfy the necessary marginal condition for profit maximization with respect to the use of hired labor. A statistical hypothesis test maintained constant returns to scale in Korean rice farming. However, no conclusion can be drawn about the nature of scale economies. The issue will be further investigated in the following sections.

5.2 ECONOMIES-OF-SCALE

In this section, economies, and diseconomies, of scale are examined with the scatter diagram approach and the survivor technique. These two methods are simple in application, but they can provide additional evidence on the actual extent, if any, of scale economies. If the results from these analyses are consistent and compatible with that of the profit function analysis, then the relationship between farm size and economic efficiency in Korean rice farming would be more clearly understood.
5.2.1 Scatter Diagram Approach

The intent of drawing an envelope curve from a scatter diagram of unit cost and output volume is to find the lowest possible unit costs at various output scales. The intent is to fit the bottom edge of the cost-volume scatter diagram to a 'frontier' long-run average cost curve.

This approach was applied to the 933 sample farms which were used in the profit function analysis. In the scatter diagram, the vertical axis shows unit production cost per kilogram of rice and the horizontal axis shows volume of produced rice in kilograms. The unit production costs include variable and fixed costs, taxes and fees, and imputed costs of land, capital, and family labor. The value of by-products is subtracted from total production costs.

From the diagram, the lowest points at various levels of output are drawn for each farm size. Figure 5.1 presents the 'frontier' average cost curve by farm size. AC1 shows the average cost curve for small farms; AC2 the average cost curve for medium farms; AC3 for large farms; and AC4 for extra-large farms. From the Figure 5.1, we can see that the AC2 curve contains the lowest average cost among the four unit cost curves. But it is not considerably lower than the AC1 curve. The average cost curve for large farms,

\[2\] The original cost-output scatter diagram is given in Appendix Figure D.1.
Figure 5.1: The Lowest Cost Points at Various Output Levels by Farm Size in Rice Production
AC3, shifts up over AC1 and AC2. If we construct a long-run average cost curve with AC1, AC2, and AC3, which is within permitted land size under current land law, the three curves make a nearly U-shaped long-run average cost curve. This suggests an optimum scale within medium sized farms. The lowest possible unit cost is assumed to determine the optimum scale. This is consistent with the results of the relative economic efficiency analysis performed with the profit function model.

Now consider the average cost curve for extra-large farms, AC4. The lowest point on AC4 is lower than that on AC3. This leads to an interesting implication in connection with the legal limitation of 3 hectare land size. AC1 and AC2 do not significantly differ in their lowest points. However, the unit costs for farms between 2 to 3 hectares appear much higher relative to the smaller farm size classes. Further the cost curve for farms over the 3 hectare limitation, AC4, falls to a lower level than AC3. This implies that within the limitation of the 3 hectare ceiling, farming technology is confined to traditional operations which are typically labor-intensive. With this type of technology, the long-run average cost curve cannot continue to descend as farm size gets bigger. Thus the long-run average cost curve becomes a U-shaped one within
the 3 hectare farm size. In contrast, the extra-large farms, for whatever reasons they may be cultivating more land than legally permitted, can adopt labor-saving large farm machinery and equipment in order to reduce production cost in the face of rapidly increasing wage rates in rural areas. When AC4 is included, the long-run average cost curve no longer appears as a U-shaped curve. Rather, it resembles a W-shaped one. When one is determined to integrate all short-run average cost curves into a U-shaped envelope curve, one must at least assume that the alternative technological processes, which can be used at different levels of output, become progressively more efficient until a certain crucial point is reached, after which they become less efficient (Malanos, p.255). However, in the case of Korean agriculture, technological alternatives are discontinuous and have not been adopted in each case in a manner which reveals the full range of increasing and decreasing returns to scale. It is, therefore, difficult to determine which farm size is optimal in Korean farming from this survey data. If we include only AC3 and AC4 in drawing an envelope curve, a declining long-run average cost curve can be expected. What we can conclude from the scatter diagram analysis is that given the

25 The expected economic efficiency beyond 3 hectares is hypothetically explained in Section 5.4 of this chapter.
existing legal limitation on land ownership, within the class of medium sized farms with 1 to 2 hectares of cultivating area is the optimal scale in Korean rice farming.

5.2.2 **Survivor Technique**

The survivor technique can be used to determine an optimal size under the assumption that, in the long-run, farm sizes which are efficient will survive and make up an increasing share in the industry. The farm size surviving the best has minimal production costs.

The survivor technique is applied to Korean agriculture in two ways: first, the distribution of farm households by farm size over time is examined, and second, for each farm size class the average production cost for rice is compared.

Table 5.4 shows the proportional distribution of farm households by farm size from 1965 to 1979. The total number of farm households, in each farm class, has been decreasing over the period. In fact, the method in this case simply shows which farm size class has lost relatively less farms during the period.

Among the four farm size classes, the medium size, 1 to 2 hectares, registers a slightly increasing proportion from 1965 to 1979. During the period, its proportion changed from
### TABLE 5.4

Proportion of Farm Households by Farm Size\(^a\), 1965 - 1979

<table>
<thead>
<tr>
<th>Year</th>
<th>Farm Size Class</th>
<th>Total Number of Farm Household (1,000 Households)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Less than 1 ha</td>
<td>1 - 2 ha</td>
</tr>
<tr>
<td>1965</td>
<td>67.6</td>
<td>25.6</td>
</tr>
<tr>
<td>1970</td>
<td>67.8</td>
<td>25.7</td>
</tr>
<tr>
<td>1975</td>
<td>66.5</td>
<td>27.0</td>
</tr>
<tr>
<td>1979</td>
<td>67.6</td>
<td>26.8</td>
</tr>
</tbody>
</table>

Note: \(^a\)Excluding Non-Crop Farms

25.6 percent to 26.8 percent. On the other hand, the proportion of 2 to 3 hectare size farms decreased from 5.6 percent to 4.3 percent during the same period. Almost the same proportions have been kept for farms of less than 1 hectare size and over 3 hectare size from 1965 to 1979.

Following the proposition underlying the survivor technique, one may argue that 1 to 2 hectare farms would be optimal. However, this may not be a strong evidence of economies-of-scale, because during the concerned period, the relative proportion of each size class has not shown a distinctive trend. No size class shows more than two percent change in its proportion from 1965 to 1979. This is because the period from 1965 to 1979 is not long enough to provide a long-term trend, and the farm households involved in the comparison are not homogeneous in crop production. They often cultivate upland crops as well as rice.

Turning our focus to rice production, the average production cost per 80 kilograms of hulled rice is analyzed by farm size.\textsuperscript{26} Using average cost data, each year's efficiency index was computed by dividing each year's lowest production cost among farm size classes by the production cost of each class. If the efficiency index is 100, the

\textsuperscript{26} The data were obtained from the \textit{Report of the Results of Production Cost Survey of Agricultural Products} which is annually published by the Ministry of Agriculture & Fisheries, Korea.
size class has the lowest average cost in that year. Table 5.5 presents these indexes.

From 1967 to 1981, the medium size classes including 1.0-1.5 hectare and 1.5-2.0 hectare size have shown an efficiency index of 100 for all but 5 years. In those 5 years, the efficiency index of 100 accrued to the large size class cultivating more than 2 hectares of farm land. Over the period, the average cost advantage was never with farms of less than 1 hectare.

We can divide the years into a pre-high yielding variety (HYV) period and post-HYV period. The pre-HYV period spans the time from 1967 to 1972. Although the first HYV was introduced in 1971, it was not widely disseminated to farms until 1973. The post-HYV period starts in 1973.

Determining the efficiency index, we find that the two periods display different patterns. In the pre-HYV period, the 1.0 to 1.5 hectare farm size class accounts for all the 100 efficiency index scores except for 1968. On the other hand, during the post-HYV period, this size class accounts for only one 100 efficiency index, i.e., in 1976. In all other years, the highest efficiencies are evenly distributed to 1.5-2.0 hectare class and the more than 2.0 hectare class.
### TABLE 5.5
Efficiency Index\(^a\) of Average Production Cost\(^b\) per 80 kg of Hulled Rice Grain by Farm Size, 1967-1981

<table>
<thead>
<tr>
<th>Year</th>
<th>Farm Size Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Less than 0.5 ha</td>
</tr>
<tr>
<td>1967</td>
<td>98.5</td>
</tr>
<tr>
<td>1968</td>
<td>89.3</td>
</tr>
<tr>
<td>1969</td>
<td>94.2</td>
</tr>
<tr>
<td>1970</td>
<td>89.0</td>
</tr>
<tr>
<td>1971</td>
<td>96.2</td>
</tr>
<tr>
<td>1972</td>
<td>81.6</td>
</tr>
<tr>
<td>1973</td>
<td>82.2</td>
</tr>
<tr>
<td>1974</td>
<td>83.0</td>
</tr>
<tr>
<td>1975</td>
<td>90.2</td>
</tr>
<tr>
<td>1976</td>
<td>93.2</td>
</tr>
<tr>
<td>1977</td>
<td>87.1</td>
</tr>
<tr>
<td>1978</td>
<td>95.6</td>
</tr>
<tr>
<td>1979</td>
<td>91.3</td>
</tr>
<tr>
<td>1980</td>
<td>98.7</td>
</tr>
<tr>
<td>1981</td>
<td>94.0</td>
</tr>
</tbody>
</table>

Note: \(^a\)Efficiency Index is calculated each year by the following formula: Efficiency Index = (The Lowest Average Production Cost among Farm Size Groups in each year)/(The Average Production Cost of each Farm Size Group) x 100.

\(^b\)By-product Value is subtracted from the Production Cost. Average Production Cost is given in Appendix Table D.1.

This trend may imply that a technological change resulted in different patterns of scale economy. Before the introduction of the new high yielding variety, a farm size of 1.0 to 1.5 hectare could enjoy cost advantage with traditional farming practices. With the introduction and diffusion of the new varieties, rice farming practices changed to incorporate more advanced technologies of fertilization, irrigation and drainage, pest control, and hot nursery beds. These modern practices might be more efficiently adopted by larger farms, especially in the case of irrigation and drainage facilities. Therefore, in the post-HYV period, farms with more than 1.5 hectares have been relatively advantageous in terms of average production cost. Even though higher economic efficiency moved from the 1.0-1.5 hectare size to the 1.5-2.0 hectare size after the introduction of HYV technology, it has remained within 1 to 2 hectare range for all but 5 years of the 15 years since 1967.

5.2.3 Summary

Considering the economies-of-scale in rice production, the scatter diagram of cost-volume relation, the proportional distribution of farm households by farm size, and the efficiency index of average production cost were
examined. Although we can not provide any statistical testing for the economies-of-scale from these analyses, we can demonstrate a result similar to that derived in the profit function analysis for the test of relative economic efficiency. Results consistently suggest that medium sized farms, cultivating between 1 to 2 hectares of farm land, enjoyed higher economic efficiency and optimum scale under the current context of the land law in Korea. But this does not rule out the possibility that economies of scale can continue for farm sizes beyond 3 hectares; and as a result even higher economic efficiencies could be achieved at larger scales if the legal constraints of the land law were to be removed.

5.3 **ANALYSIS OF FACTOR USE ADJUSTMENT**

The purpose of this section is to analyze the factor adjustment process. When considering allocative efficiency in the previous section, farmers' resource allocation was examined within a static context: that is, whether they equated their marginal value product of a factor to its opportunity cost in a particular year. However, an examination of how farmers reallocated their resources to meet optimality conditions over time could not be carried out.
Farm resources are adjusted by farmers in response to a sequence of changes in agriculture. This adjustment process can be analyzed under the assumption that the actual adjustment between any two years is a constant proportion of the extent of own-factor disequilibrium.

5.3.1 Model Specification and Estimation

Before specifying the adjustment model, an explanation of the data used in this analysis is needed. The factor costs of rice production inputs were obtained for the period from 1963 to 1981. The published cost data include input expenses per tenth of an hectare of cultivated land. In order to obtain average expenditures for each factor per farm, the cost per tenth of an hectare was multiplied by the units of cultivated paddy land per farm. In addition, the report classifies farm sizes into five categories: (1) less than 0.5 hectare, (2) 0.5 to 1.0 hectare, (3) 1.0 to 1.5 hectares, (4) 1.5 to 2.0 hectares, and (5) 2.0 hectares and over. These categories are regrouped into 3 farm size classes using the number of surveyed farms in each category as the weight of the category. The three farm size classes become (1) less than 1.0 hectare, (2) 1.0 to 2.0 hectares, (3) 2.0 hectares and over.

27 The data source is Report of the Results of Production Cost Survey of Agricultural Products, which is annually published by Ministry of Agriculture & Fisheries, Korea.
and (3) 2.0 hectares and over. According to the farm size definition in the section 5.1.1, these are small farms, medium farms, and large farms.

Based on equation (4.27), the basic distributed lag model can be expressed in stochastic form as

\[(5.3) \Phi(t) = a + b \Phi(t-1) + e(t)\]

where \(a = \lambda E^*(t)\) and \(b = 1 - \lambda\). Thus, \(E^*(t)\), the equilibrium factor share, equals \(a/(1 - b)\). And, the adjustment coefficient, \(\lambda\), becomes \((1 - b)\). Postulating that the equilibrium factor share changes from period to period due to the changes in technological and economic conditions, we will estimate the resource adjustment model by fitting the following equation for labor, fertilizer, and agricultural chemicals including pesticides, insecticides, and herbicides:

\[(5.4) \Phi(t) = a' + d1 D1 + d2 D2 + d3 D3 + d4 D4 + b \Phi(t-1) + e(t)\]

where \(\Phi(t) =\) actual factor share at time \(t\),

\(D_i =\) zero one dummy variable for each time period

\((i = 1, 2, 3, 4)\).

The period from 1963 to 1981 was divided into five sub-periods. The division of time period is somewhat arbitrary, but it represents the stage of technological change in those periods, particularly after the diffusion of HYV rice. The five sub-periods are as follows: (1)
1963-1967, (2) 1968-1971, (3) 1972-1974, (4) 1975-1977, and (5) 1978-1981. Thus dummy variable \( t \) corresponds to the order of these periods except for the period of 1978-1981. Equation (5.4) allows \( \varepsilon^*(t) \) to vary between periods depending on the \( d_i \) values \((i=1,2,3,4)\). The estimates are \( \varepsilon^*(1963-67) = (a' + d_1)/(1 - b), \text{ et c.}, \) with \( a'/(1 - b) \) being the estimate for the 1978-1981 period.

In equation (5.4), the lagged dependent variable appears as an explanatory variable. The disturbance terms are expected to be serially correlated. The Hildreth-Lu procedure is used to obtain parameter estimates. The parameters of the fitted equations are reported in Appendix Table D.2, D.3, and D.4. Labor input consists of both family and hired labor. Fertilizers include only chemical fertilizers. Agricultural chemicals are pesticides, insecticides, herbicides, etc. These three factors are the most important ones among variable inputs in terms of factor share in rice production.

Using the estimated parameters, the adjustment coefficients, \( \lambda 's \), are obtained for the three inputs. The computed coefficients are presented in Table 5.6. In every farm size class, the adjustment coefficients for the three factors are higher than 0.6. This implies that Korean farmers have adjusted their variable inputs fairly well,
though not promptly, toward equilibrium levels during the period from 1963 to 1981.

TABLE 5.6
Partial Adjustment Coefficients for Variable Inputs in Korean Rice Production by Farm Size, 1963-1981

<table>
<thead>
<tr>
<th>Farm Size Classes</th>
<th>Labor</th>
<th>Fertilizers</th>
<th>Chemicals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1.0 ha</td>
<td>0.69</td>
<td>0.67</td>
<td>0.79</td>
</tr>
<tr>
<td>1.0-2.0 ha</td>
<td>0.61</td>
<td>0.70</td>
<td>0.66</td>
</tr>
<tr>
<td>2.0 ha and over</td>
<td>0.80</td>
<td>0.74</td>
<td>0.73</td>
</tr>
</tbody>
</table>

In the case of labor inputs, the large farm size class (2.0 hectares and over) shows the highest adjustment coefficient, 0.8. In utilizing labor input, large farms might be very sensitive to the changing economic or technical conditions because they rely on relatively more hired labor than smaller farms. The higher the proportion of hired labor to total labor, the easier it is to adjust downward in labor use by simply reducing labor inputs. For fertilizers and chemicals, the three size classes are not much different in their abilities to adjust.
Optimal factor shares are calculated from the estimated equations. Table 5.7 shows the optimal factor shares and the ratio of actual versus optimal shares. All the estimated equilibrium factor shares are of the right sign, and the average actual factor share of each input for each sub-period appears to be close to the optimal share. Except for the period from 1963 to 1967, the percentage difference between estimated optimal share and actual share is less than 15 percent for the three inputs.

5.3.2 Summary

From partial adjustment analysis, it was found that Korean rice farmers have been able to adjust variable inputs, including labor, fertilizers, and chemicals, toward optimal factor share levels at a reasonably good pace during the period 1963-1981. No significant differences were seen among the different farm size classes in the adjustment processes. However, in adjusting labor input, the statistical evidence reveals that farms with over two hectares of farm land were more adaptable to changing conditions than their smaller counterparts.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor (I)</td>
<td></td>
<td>22.4</td>
<td>24.8</td>
<td>21.9</td>
<td>16.8</td>
<td>22.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.95)</td>
<td>(0.99)</td>
<td>(1.00)</td>
<td>(1.08)</td>
<td>(0.95)</td>
</tr>
<tr>
<td>Labor (II)</td>
<td></td>
<td>21.7</td>
<td>22.5</td>
<td>20.0</td>
<td>14.9</td>
<td>22.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.94)</td>
<td>(0.99)</td>
<td>(1.01)</td>
<td>(1.12)</td>
<td>(0.93)</td>
</tr>
<tr>
<td>Labor (III)</td>
<td></td>
<td>20.1</td>
<td>21.8</td>
<td>17.7</td>
<td>13.4</td>
<td>20.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.95)</td>
<td>(0.99)</td>
<td>(1.00)</td>
<td>(1.07)</td>
<td>(0.97)</td>
</tr>
<tr>
<td>Chemical Fertilizer (I)</td>
<td></td>
<td>5.9</td>
<td>3.4</td>
<td>2.0</td>
<td>4.2</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.83)</td>
<td>(1.12)</td>
<td>(1.10)</td>
<td>(0.90)</td>
<td>(1.03)</td>
</tr>
<tr>
<td>Chemical Fertilizer (II)</td>
<td></td>
<td>5.9</td>
<td>3.4</td>
<td>2.1</td>
<td>3.9</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.83)</td>
<td>(1.09)</td>
<td>(0.95)</td>
<td>(0.92)</td>
<td>(1.03)</td>
</tr>
<tr>
<td>Chemical Fertilizer (III)</td>
<td></td>
<td>6.0</td>
<td>3.6</td>
<td>2.1</td>
<td>3.7</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.85)</td>
<td>(1.06)</td>
<td>(1.05)</td>
<td>(0.95)</td>
<td>(1.03)</td>
</tr>
<tr>
<td>Agricultural Chemicals (I)</td>
<td></td>
<td>0.6</td>
<td>1.2</td>
<td>1.3</td>
<td>1.8</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.00)</td>
<td>(0.92)</td>
<td>(1.00)</td>
<td>(1.06)</td>
<td>(0.96)</td>
</tr>
<tr>
<td>Agricultural Chemicals (II)</td>
<td></td>
<td>0.8</td>
<td>1.2</td>
<td>1.5</td>
<td>1.6</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.88)</td>
<td>(1.00)</td>
<td>(0.93)</td>
<td>(1.06)</td>
<td>(0.92)</td>
</tr>
<tr>
<td>Agricultural Chemicals (III)</td>
<td></td>
<td>0.9</td>
<td>1.2</td>
<td>1.2</td>
<td>1.4</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.89)</td>
<td>(1.00)</td>
<td>(1.00)</td>
<td>(1.07)</td>
<td>(0.95)</td>
</tr>
</tbody>
</table>

Note:  
- Farm Size Classes are defined as follows:  
  (I) Less than 1.0 ha, (II) 1.0 ha - 2.0 ha, and (III) 2.0 ha and over.  
- Numbers in Parentheses are the ratios of actual vs. optimal.
5.4 AN EVALUATION OF THE RESULTS OF FARM SIZE ANALYSIS

In the previous sections, the analysis of farm size was focused on the scales within the 3 hectare legal limitation. In addition to this analysis, discussion of the scale economies beyond the 3 hectare ceiling is needed. This will help to develop better appreciation of the expected future trends in Korean agriculture.

5.4.1 Invisible Factors beyond the Barrier

The question arises whether the farms cultivating more than 3 hectares in Korea are economically inefficient relative to the smaller farms. It is possible that 3 hectare limitation is effective and should be enforced as it has been since 1950. However, there are some underlying conditions that lead one to question this and open the possibility that higher efficiency may be related to farms greater than 3 hectares.

In the previous sections, extra-large farms (more than 3 hectares) were judged relatively economic inefficient compared to the medium sized farms (1 - 2 hectares). An explanation of the above result is given below with respect to the expansion of farm scale. In Figure 5.2, the expansion path A shows the actual farm scale expansion in Korea. This expansion path is drawn through points a and b.
where the price lines P3 and P4 are tangent to the isoquants Ya and Yb, respectively. The relative price lines P3 and P4 include actual market price of factors plus some psychological cost. Under the present legal land size constraint, farmers may feel a psychological burden when they expand land size beyond 3 hectares. Thus, the relative price line gets flatter. In the extreme case, the psychological price for land would become infinite: that is, this would occur, for instance, at 10 hectares or more. The resulting expansion path is, therefore, shaped like path A.

On the other hand, expansion path B shows the hypothetical expansion path with relative price lines P1 and P2 and with isoquants Ya and Yb. In this case, the relative price lines are assumed to have the same slope along the expansion path B. We assume that the expansion path B would be possible if there were no restriction on the size of farm land.

If farmers try to produce output Yb, then on the expansion path A, the factor combination will be decided at point b, with the price level P4. However, on the expansion path B, output Yb can be obtained at point d. The actual production cost at b is reflected by P5 which is parallel to P2. From this, it can be seen that point b pays more than
Figure 5.2: Hypothetical Relationship between Economic Efficiency and Alternative Expansion Paths
point d in producing the same output. This may be a rationale underlying why farms cultivating more than 3 hectares in Korea appear to be relatively inefficient in the previous analysis. The existence of the legal provisions on farm size may be a contributing factor. Therefore, in examining the economic efficiency of rice farming in Korea, we cannot conclusively state that the lower economic efficiency of the larger than 3 hectare size farms is justification for the strict enforcement of the 3 hectare land holding limitation.

5.4.2 Technological Change and Economies-of-Scale

In spite of the labor shortage problem in rural Korea, farming technology has remained primarily a labor-intensive package. Although farm mechanization is believed to be a substitute for labor-intensive practices, current levels of mechanization in Korean agriculture do not represent a great labor-saving technology. The data in Table 5.8 reflect the level of mechanization in rural Korea. Recently, the use of farm machines has increased considerably, yet, the number of farm machines per farm is still small. And the number of large machines is particularly small when it is divided among the total number of farm households in Korea. This implies that under the present institutional framework which
includes the legal constraint of farm size, the technology applicable to Korean agriculture is oriented towards labor-intensive operations, even if some operations can be accomplished by the use of small machinery.

Different patterns of scale economies can be expected with alternative levels of technology. This is illustrated in Figure 5.3. LRAC1 in Figure 5.3 is assumed to be the long-run average cost curve for a labor-intensive technology. The curve LRAC2 is hypothetically drawn to represent the long-run average cost curve for more mechanized farming. On the curve LRAC1, point a is the lowest point before diseconomies of scale appear. On the other hand, the curve LRAC2 still shows economies of scale in this range. The average production cost on LRAC2 is higher than that on LRAC1 until two curves intersect at point c. Moreover, the level of average cost on LRAC2 is still higher than point a on LRAC1 before farm scale arrives at point b on LRAC2.

Within the limitation of 3 hectare ceiling, the long-run average cost curve may look like LRAC1 in Figure 5.3. Then, beyond the 3 hectare limitation, the long-run average cost curve would resemble LRAC2, if not exact, as we have already seen in Figure 5.1. It seems, however, that farms cultivating more than 3 hectares in rural Korea have not yet expanded to land size d in Figure 5.3.
# TABLE 5.8

Number of Machines Owned by Farm Households

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Tiller</td>
<td>1,111</td>
<td>11,884</td>
<td>85,722</td>
<td>289,779</td>
</tr>
<tr>
<td></td>
<td>(0.4)a</td>
<td>(4.8)</td>
<td>(36.0)</td>
<td>(134.4)</td>
</tr>
<tr>
<td>Tractor</td>
<td>0</td>
<td>61</td>
<td>564</td>
<td>2,644</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0.02)</td>
<td>(0.24)</td>
<td>(1.2)</td>
</tr>
<tr>
<td>Power Sprayer</td>
<td>7,579</td>
<td>45,008</td>
<td>137,698</td>
<td>332,912</td>
</tr>
<tr>
<td></td>
<td>(3.0)</td>
<td>(18.1)</td>
<td>(57.9)</td>
<td>(154.4)</td>
</tr>
<tr>
<td>Cutter</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15,628</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
<td>(0)</td>
<td>(7.2)</td>
</tr>
<tr>
<td>Power Thresher</td>
<td>18,909</td>
<td>41,038</td>
<td>127,105</td>
<td>219,896</td>
</tr>
<tr>
<td></td>
<td>(7.5)</td>
<td>(16.5)</td>
<td>(53.4)</td>
<td>(102.0)</td>
</tr>
<tr>
<td>Combine</td>
<td>0</td>
<td>0</td>
<td>56</td>
<td>1,211</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
<td>(0.02)</td>
<td>(0.56)</td>
</tr>
<tr>
<td>Power Transplanter</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>11,061</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
<td>(0.01)</td>
<td>(5.13)</td>
</tr>
<tr>
<td>Water Pump</td>
<td>26,029</td>
<td>54,078</td>
<td>65,993</td>
<td>193,943</td>
</tr>
<tr>
<td></td>
<td>(10.4)</td>
<td>(21.8)</td>
<td>(27.7)</td>
<td>(90.0)</td>
</tr>
</tbody>
</table>

Note: Numbers in parentheses are the number of machinery per 1,000 farm households.

Figure 5.3: Scale Economies with Alternative Farm Technologies
5.4.3 Farm Household Survival in a Growing Economy

A farmers' primary concern is income for survival. Income should at least exceed the living expenses. And if there exists some residual after paying living expenditures, a portion should be re-invested in the farm business. Table 5.9 compares agricultural income, which is defined as agricultural gross receipts less management expenditures, and farm living expenses. On the average, income from agricultural activities was not even enough to cover farm living expenses in 1981. The deficit was usually made up from off-farm income. In general, farmers cannot rely solely on agricultural income to cover living expenses if the farm is less than 1 hectare. Farms cultivating less than 1 hectare comprise about two-thirds of total farm households in Korea.

Per capita agricultural income is an important indicator of the economic achievement in farming. In Table 5.10, per capita agricultural income is compared with the average per capita urban household income and per capita GNP in 1981. On the average, per capita agricultural income is 66 percent of the per capita urban household income, and 45 percent of per capita GNP in 1981. A comparison by farm size indicates that only the larger farm sizes with more than 2 hectares have higher per capita incomes than that of
TABLE 5.9
Agricultural Income and Living Expenses per Farm by Farm Size, 1981

<table>
<thead>
<tr>
<th>Farm Size Classes</th>
<th>Agricultural Income (A)</th>
<th>Living Expenses (B)</th>
<th>(A - B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 0.5 ha</td>
<td>912,732</td>
<td>2,180,167</td>
<td>-1,267,435</td>
</tr>
<tr>
<td>0.5 - 1.0 ha</td>
<td>2,015,026</td>
<td>2,378,083</td>
<td>-363,057</td>
</tr>
<tr>
<td>1.0 - 1.5 ha</td>
<td>2,948,012</td>
<td>2,788,978</td>
<td>159,034</td>
</tr>
<tr>
<td>1.5 - 2.0 ha</td>
<td>3,890,317</td>
<td>3,387,505</td>
<td>502,812</td>
</tr>
<tr>
<td>2.0 ha and over</td>
<td>5,101,332</td>
<td>3,904,572</td>
<td>1,196,760</td>
</tr>
<tr>
<td>Average</td>
<td>2,476,463</td>
<td>2,676,090</td>
<td>-199,627</td>
</tr>
</tbody>
</table>

Source: Ministry of Agriculture & Fisheries, Korea, Report on the Results of Farm Household Economy Survey, 1982

Urban households. Farms cultivating less than 2 hectares earn less per capita agricultural incomes than the average per capita income of urban households. This is an important force in the migration of rural people to urban areas.

If it is desired that agriculture be an industry which supports farm families at a living standard equivalent to the average level of the urban households, then farm sizes must be increased. Although farm sizes of larger than 2 hectares have a higher per capita income than the average
<table>
<thead>
<tr>
<th>Farm Size Classes</th>
<th>Per capita Agricultural Income (Won)</th>
<th>Percentage of per capita Agriculture Income of Average per capita Urban Household Income(a)</th>
<th>per capita GNP(b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 0.5 ha</td>
<td>219,407</td>
<td>29.6</td>
<td>20.0</td>
</tr>
<tr>
<td>0.5 - 1.0 ha</td>
<td>412,915</td>
<td>55.6</td>
<td>37.7</td>
</tr>
<tr>
<td>1.0 - 1.5 ha</td>
<td>545,928</td>
<td>73.5</td>
<td>49.9</td>
</tr>
<tr>
<td>1.5 - 2.0 ha</td>
<td>694,699</td>
<td>93.6</td>
<td>63.5</td>
</tr>
<tr>
<td>2.0 ha and over</td>
<td>840,417</td>
<td>113.2</td>
<td>76.8</td>
</tr>
<tr>
<td>Average</td>
<td>490,389</td>
<td>66.0</td>
<td>44.8</td>
</tr>
</tbody>
</table>

Note: \(a\) Average per capita Urban Household Income was 742,607 Won in 1981.

\(b\) Per capita GNP was 1,094,882 Won in 1981.

urban household, this income is still lower than the per capita GNP. This implies that a balanced economic growth between the agricultural sector and the industrial sector is not an easy task to achieve, even with an average farm size larger than 2 hectares.

5.4.4 Recapitulation

In this section, the hypothetical possibility of farms larger than 3 hectares was discussed with respect to farm expansion paths and technological changes. A suggestion obtained from this discussion is that, in determining an optimal scale in Korean farming, a careful consideration should be given to the expected economic efficiency beyond 3 hectares under alternative conditions.

Analysis indicates that 1 to 2 hectare farms are relatively more efficient than other farms. However, its higher economic efficiency is an outcome under the 3 hectare farm size constraint which has been existent since 1950. Thus, this may be subject to careful interpretation because of the possible impact of the 3 hectare size limitation on economic efficiency indicators. Moreover, a self-supporting agricultural industry and an equi-balanced economic growth between the agricultural sector and the non-agricultural sector requires a farming structure with a larger than that presently exists.
Chapter VI

TENANCY AND ALLOCATIVE EFFICIENCY

Land tenure system has generally been linked with economic development, being considered a significant factor in providing farmers with incentives to adopt improved technologies and raising their farming efficiency. In this regard, share tenancy has been particularly singled out as a problem area in relation to allocative efficiency.

The aim of this chapter is to analyze the relationship between tenancy practices and allocative efficiency in Korean rice farming. There are two issues of concern in this chapter. The first is related to the tenant farmers' resource allocation. The profit function model is again applied as the analytical tool for this purpose. The second issue concerns the functioning of the rental market. Multiple regression model based upon theoretical consideration is specified for examining factors influencing the demand for land by tenant farmers.
6.1 **EFFICIENCY VERSUS INEFFECTIVENESS**

There are two different approaches discussing the economic efficiency of sharecropping. The tax-equivalent\(^{28}\) approach criticizes share contracts because the sharecropper will not allocate his resources as efficiently as the owner-cultivator or the fixed rent tenant. On the other hand, Cheung's approach\(^{29}\) argues that the pattern of resource allocation under share tenancy will be determined at market equilibrium and satisfies the Pareto condition.

The two approaches rely on different basic assumptions.\(^{30}\) These basic assumptions appear to be the root of the conflicting results. Cheung (1969a) rejects the inefficiency doctrine advocated by the tax-equivalent approach. His criticism of this approach centers on two premises. First, the tax-equivalent argument is based on the assumption that the terms of a share contract are determined by custom. On this assumption, Cheung (1969a, p. 28).

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\(^{28}\) The term "tax-equivalent" is based on an analogy drawn between a share rent and an excise tax (Cheung 1969a, p. 30).

\(^{29}\) Although both Johnson (1950) and Cheung (1969a) use similar analytical frameworks in their discussion, Cheung's analysis of resource allocation under share tenancy is in a more rigorous form and his argument is more in direct contrast with the "tax-equivalent" approach (Park, p. 219).

\(^{30}\) The arguments of the two approaches are in detail presented in Appendix A.
argues that:

... by "custom" they meant a situation where the postulate of wealth or utility maximization does not apply. Yet without any such behavioral postulate, the meaning of competition cannot be defined.

Thus, Cheung (1969a, p. 30) emphasizes market competition by stating:

In the tax-equivalent approach, the writers generally fail to realize that the percentage shares and area rented under share tenancy are not mysteriously "fixed" but are competitively determined in the market.

Cheung's argument necessitates the assumption that the terms of a share contract are determined by market competition for wealth or utility maximization.

In the tax-equivalent argument, there is an implicit assumption that once the rate of rent is determined, the tenant has freedom to decide how he utilizes farming inputs. Cheung (1969a, p. 31) accepts this assumption, and then argues that as long as the landlord maximizes his rental annuity, resource utilization by the tenant would be optimally determined through the market mechanism. Therefore, all that Cheung argues and presents is the analytical framework formulated in a general equilibrium assumption.

One of the main criticisms against Cheung's theory of share tenancy focuses on the market power which accrues to
the landlord. Koo (p. 21) argues that Cheung overlooks the monopoly element of the land market, and points out that:

In Cheung's model, the landlord has control over both proportional (sharecropping) rate and quantity (number of pieces of land). He has more power than a monopolist.

In addition, Bardhan and Srinivasan (1974) mathematically argue that, if one does not allow the landlord the choice of a proportional rate, then Cheung's argument on the efficient allocation of resources cannot be valid. The exception to this is an implied special case where either the proportional rate equals zero, or the land elasticity in the production function equals the rental rate if the rate is not zero (Bardhan and Srinivasan 1974, pp. 1067-69).

Moreover, when monopoly power exists in factor ownership, the Pareto optimality condition cannot be satisfied.

We have examined how the different assumptions result in the conflicting conclusions in the analysis of resource allocation under share tenancy. It appears that the validity of either theory cannot be verified without further evidence provided from empirical investigations. It will depend on how the rental market is formed and functions in an economy. In the following section, we will empirically investigate the allocative efficiency of Korean tenant farmers in producing rice.
6.2 **ANALYSIS OF ALLOCATIVE EFFICIENCY UNDER TENANCY**

The purpose of this section is to analyze how tenant farmers utilize their variable inputs on the leased land. The question is whether tenant farmers use as much variable inputs as owner operators do. If the tenant farmers utilize variable inputs as efficiently as owner operators, then the tenant operators would allocate their inputs to the point where the marginal value product of an input equals its price. This condition is equivalent to the case where total revenue, which is defined as the total value product minus variable cost, is to be maximized. If sharecropping tenants behave as asserted by the tax-equivalent approach, then they would utilize variable inputs to the point where their share of the marginal value product of an input equals its price; they are maximizing their own share of total revenue. In this respect, we may infer from the tenant farmers' maximizing behavior the level of allocative efficiency. Maximizing total revenue would imply efficient resource allocation, whereas maximizing a tenant farmers' own share of total revenue would mean inefficient resource allocation under share tenancy.
6.2.1 **Data and Tenant Group Definition**

For the analysis of tenant farmers' allocative efficiency, we selected 374 tenant farms from the same data source which was used in the economic efficiency analysis of owner farmers in the previous chapter -- the 1977 cross-section survey of rice production costs. The criteria for selecting a sample of tenant farms from the original data base were also the same as those applied to selecting owner farms: i.e., more than 50 percent of both total farm lands in paddy culture and total value of farm output from rice production.

Unfortunately, the data do not contain information about the forms of tenant contracts such as fixed-rent contract, sharecropping, etc. Related to the available tenancy practices are the units of tenanted land and the value of total rent paid. Although the allocative efficiency problem in the literature is concerned mainly with share tenancy, data limitations prevent focusing on this narrow issue of only sharecroppers. In this study, allocative efficiency of tenancy is analyzed for all the selected tenant farms irrespective of the form of contracts.

Nevertheless, an analysis of allocative efficiency of tenancy, whether based on sharecropping or not, would still provide important implications. We knew from other research
that more than 30 percent of total tenant farmers were sharecroppers in 1976 (see Oh, pp. 50-51). Thus, if we find from sample that Korean tenant farmers are maximizing their share of total revenue, then it may imply that about one third of the tenant farmers who are believed to be share tenants are not efficiently allocating variable inputs on the tenanted land.

In this analysis, tenants farmers are classified into three groups on the basis of the percentage of tenanted area to the total cultivated area (Table 6.1):

a) Owner-tenants: farmers cultivating tenanted lands that are less than or equal to 50 percent of their total cultivated lands.

b) Tenant-owners: farmers with greater than 50 percent, but less than 100 percent of a tenanted lands to total cultivated lands ratio.

c) Full-tenants: farmers who cultivate only tenanted lands.

We will focus our attention on each of those classes of tenant operators because it is expected that farm management decisions differ by the different proportions of leased land to total operating land size.
TABLE 6.1
Selected Tenant Farmers by Tenancy Classification

<table>
<thead>
<tr>
<th>Tenant Classification</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner-tenants</td>
<td>172</td>
<td>46.0</td>
</tr>
<tr>
<td>Tenant-owners</td>
<td>106</td>
<td>28.3</td>
</tr>
<tr>
<td>Full-tenants</td>
<td>96</td>
<td>25.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>374</td>
<td>100</td>
</tr>
</tbody>
</table>

6.2.2 Model Specification

In specifying the UOP profit function model, the same variables except for dummy variables were selected that were used in analyzing economic efficiency of the owner operated farms. This was done for comparison purposes. If the comparative analyses are conducted with different specifications, then the results may not provide valid implication with respect to the allocative efficiency of the tenant farmers versus the owner farmers.

However, we define two different nominal profits. The first one is defined as the total value product less the cost of hired labor. This definition is the same as the one used in the profit function for owner farmers. If tenant farmers show that they maximize similarly defined profits, then their allocative efficiency is equivalent to that of
owner farmers. This would sustain Cheung's efficiency theory.

The second nominal profit is defined as total value product minus the cost of hired labor and the rental payments. If it is found that tenant farmers are maximizing this second defined profit, then they are inefficient in allocating hired labor as long as some proportion of them are sharecroppers. This is the expected result of the tax-equivalent argument. Therefore we have two profit function models.

A. Model I

\[ (6.1) \ln \pi_1 = \ln A + \alpha \ln w + \beta_1 \ln L + \beta_2 \ln FN + \beta_3 \ln K \]

\[ (6.2) \frac{w \cdot HN}{\pi_1} = \alpha' \]

where: \( \pi_1 \) = the normalized UOP profit in Korean Won, which is obtained by dividing the amount of total value product minus hired labor cost by the unit price of output.

\( w \) = the hourly wage rate divided by the unit price of output.

\( L \) = the units of cultivated paddy land in pyung.

\( FN \) = the family labor as expressed in man-equivalent labor force in hours.
K = the imputed capital charges for the fixed and
flow capital used in growing rice.

HN = the hired labor in hours used in producing rice.

B. Model II

\[(6.3) \ln \frac{\pi_2}{\pi_1} = \ln A' + a \ln w + b_1 \ln L + b_2 \ln FN
+ b_3 \ln K\]

\[\frac{w \cdot HN}{\pi_2} (6.4) = a'\]

where \(\pi_2 = \pi_1\) minus UOP-normalized rent paid.

6.2.3 Hypothesis Test of Allocative Efficiency

The hypothesis to be tested in this study is the
absolute allocative efficiency, i.e.,

\(H_0: a = a'\) for Model I or

\(H_0: a = a'\) for Model II.

If we cannot reject the null hypothesis for Model I, we can
conclude that most tenant farms equate the marginal value
product of hired labor to the wage rate. Thus their
allocative efficiency is not different from that of owner
farmers. This in turn would support the theory that the
existence of sharecropping tenancy does not affect the
optimal resource allocation. On the other hand, if we
reject the null hypothesis, we will go on to the hypothesis test for Model II. If the null hypothesis for Model II cannot be rejected, it implies that the share tenancy results in allocative inefficiency. In other words, a sharecropper would allocate hired labor to the point where his share of the marginal value product of hired labor, \((1 - r)MVP\), equals wage rate.

Model I is jointly estimated by the method of seemingly unrelated regression and reported in Table 6.2. For all the tenant groups, the estimated parameters are similar to those for owner farmers reported in Chapter V, except for the parameter for wage rate. The three tenant groups show positive coefficients for the wage variable. This is contradictory to the profit function's property as a decreasing function in the normalized price of variable input. Thus the estimated functions in Model I cannot be used for the analysis of absolute allocative efficiency.

Table 6.3 presents the estimated equations with Model II specified. As we have already noted, in defining the UOP profit in Model II, the normalized rental payment is subtracted from the UOP profit defined in Model I.

With Model II, the wage coefficient for tenant-owners and full-tenants becomes negative. But, for the owner-tenants, it is still positive. The profit function is
TABLE 6.2

Joint Estimation of UOP Profit Function and Factor Demand Function for Tenant Farmers in Rice Production, 1977: Model I

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Tenant Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Owner-Tenants</td>
</tr>
<tr>
<td>Profit Function</td>
<td></td>
</tr>
<tr>
<td>ln A</td>
<td>0.4254</td>
</tr>
<tr>
<td></td>
<td>(1.6422)</td>
</tr>
<tr>
<td>α</td>
<td>0.2082</td>
</tr>
<tr>
<td></td>
<td>(2.6486)</td>
</tr>
<tr>
<td>β₁</td>
<td>0.8700</td>
</tr>
<tr>
<td></td>
<td>(15.4614)</td>
</tr>
<tr>
<td>β₂</td>
<td>-0.0197</td>
</tr>
<tr>
<td></td>
<td>(-0.5182)</td>
</tr>
<tr>
<td>β₃</td>
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</tr>
<tr>
<td></td>
<td>(3.1005)</td>
</tr>
</tbody>
</table>

Hired Labor Demand Function

| α'                  | -0.0536            | -0.0409       | -0.0594      |
|                     | (-13.9165)         | (-7.6487)     | (-10.4174)   |

Weighted R² for System

|                  | 0.80               | 0.73          | 0.78         |

Note: Numbers in Parentheses are asymptotic t-ratios.
**TABLE 6.3**

Joint Estimation of UOP Profit Function and Factor Demand Function for Tenant Farmers in Rice Production, 1977: Model II

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Tenant Class</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Owner-Tenant</td>
<td>Tenant-Owners</td>
<td>Full-Tenants</td>
<td></td>
</tr>
<tr>
<td><strong>Profit Function</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ln A'</td>
<td>0.1137</td>
<td>0.4663</td>
<td>-1.8086</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.3943)a</td>
<td>(0.8984)</td>
<td>(-2.8844)</td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>0.1905</td>
<td>-0.1624</td>
<td>-0.0247</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.1789)</td>
<td>(-1.3777)</td>
<td>(-0.1365)</td>
<td></td>
</tr>
<tr>
<td>b1</td>
<td>0.8772</td>
<td>0.5802</td>
<td>0.7725</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(14.0151)</td>
<td>(6.1621)</td>
<td>(5.9704)</td>
<td></td>
</tr>
<tr>
<td>b2</td>
<td>-0.0276</td>
<td>-0.0774</td>
<td>-0.1708</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.6523)</td>
<td>(-1.1810)</td>
<td>(-2.0092)</td>
<td></td>
</tr>
<tr>
<td>b3</td>
<td>0.1600</td>
<td>0.3754</td>
<td>0.4993</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.2091)</td>
<td>(4.3096)</td>
<td>(3.6627)</td>
<td></td>
</tr>
<tr>
<td><strong>Hired Labor Demand Function</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a'</td>
<td>-0.0623</td>
<td>-0.0524</td>
<td>-0.0932</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-11.2759)</td>
<td>(-8.2173)</td>
<td>(-9.3324)</td>
<td></td>
</tr>
<tr>
<td><strong>Weighted $R^2$ for System</strong></td>
<td>0.77</td>
<td>0.62</td>
<td>0.69</td>
<td></td>
</tr>
</tbody>
</table>

Note: *Numbers in Parentheses are asymptotic t-ratios.*
not well fitted for the owner-tenants with respect to the sign of the coefficient for input price. There must be some reasons the wage coefficient for the owner-tenants to appear contrary to the theoretical expectation. The reasons may include irrational decision making, inaccurate price data, lack of reliable observations, error in measurements, and so forth.

One possible explanation might be sought in the characteristics of owner-tenants. As defined, owner-tenants own 50 percent or more of the lands they cultivate. The greatest percentage of income is earned from owned land. While a certain proportion of owner-tenants may lease land to expand scale of production for the purpose of maximizing profit, others, such as close relatives of the owners, may in fact cultivate the so-called tenanted land upon request by the landowners. In the latter case, the determination of rental payment varies widely. In some cases, it may simply in the form of a ceremonial payment. For instance, preparation of food for worship services of common ancestors once or twice a year. The costs of providing food on such occasion are relatively small and not comparable to the market rate of the rental contract.

The rental payment is subtracted from total revenue when the profit is defined in the specification of Model II.
The variation of profit in Model II would thus be influenced by the wide range of the rents paid per unit of land. Since the rental payment is based upon the contract agreement, it cannot be fully explained in the profit function which is usually specified with the prices of variable inputs and the physical units of fixed inputs. Because of the wide variation in rental payments per unit of tenanted land for owner-tenants, the coefficient of the wage variable does not appear as theoretically expected.

Another possible explanation is that owner-tenants might have less incentive to maximize own-share of the revenue from the rented land than other tenants. For tenant-owners and full-tenants, the desire to maximize income from the tenanted land would be greater than owner-tenants because they would depend for a large part of their income on the tenanted lands.

In any case, we consider only tenant-owners and full-tenants for the allocative efficiency analysis. Hypotheses of absolute allocative efficiency are tested for the two tenant groups, and the results are reported in Table 6.4. The null hypothesis of absolute allocative efficiency cannot be rejected at the five percent level of significance for both tenant groups. This implies that if there are share tenants in those groups, they equate their share of
marginal value product of hired labor, \((1 - r)\text{MVP}\), to the wage rate. After all, share tenants will utilize labor input less efficiently than owner cultivators. The significance of this implication depends on the proportion of share tenants among the selected tenant farmers.

### TABLE 6.4

Testing of Absolute Allocative Efficiency Hypotheses for Tenant Farmers

<table>
<thead>
<tr>
<th>Tenant Class</th>
<th>Hypothesis Tested</th>
<th>Computed F-ratic and Degrees of Freedom</th>
<th>Result of the Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenant-owners</td>
<td>(a' = a)</td>
<td>0.155(1,186)</td>
<td>Maintained</td>
</tr>
<tr>
<td>Full-tenants</td>
<td>(a' = a)</td>
<td>0.894(1,206)</td>
<td>Maintained</td>
</tr>
</tbody>
</table>

#### 6.2.4 Summary

The profit function was used to analyze the allocative efficiency of tenant farmers who were classified into three groups: owner-tenants, tenant-owners, and full-tenants. Two models were specified for the profit function and labor demand function.

In the first model, profit was defined as the total value product minus the cost for hired labor. In all tenant groups, the estimated profit functions of this first model
were not decreasing functions of the price of the variable input, wage rate. The implication is that none of the tenant operator classes meet the marginal condition for maximizing the profit defined by the model.

A second model was specified by a different profit variable. The rent paid was subtracted from the total revenue in defining the tenant's share of profit. Results show that tenant-owners and full-tenants satisfied the absolute allocative efficiency condition with respect to the use of hired labor. Thus they maximized their own share of total revenues. The implication is significant in that the validity of the inefficiency proposition can be maintained in the case of Korean agriculture to the extent that there exist sharecropping practices.

6.3 DEMAND FOR AND SUPPLY OF LAND UNDER TENANCY

Economic efficiency under tenancy would ultimately be influenced by the structure or mechanisms of the rental market. However, it is not so easy to characterize a rental market in a simple model because of many local factors. A wide variety and complex geographical and farm managerial conditions influence the structure of the market system. One possible way to view a rental market situation is to relate rental market theory to actual tenancy practices.
In this section, theories of rental market will be presented in order to provide a rational basis for considering the possible determinants of demand for lease lands. These rationalized determinants will then be tested against the actual functioning of the rental market with the aid of multiple regression analysis. This is to examine a relationship between the theoretical expectation and the actual tenancy practices in Korean agriculture. In addition, we will compare the trends of leased-in and leased-out land over a specified period of time to provide an insight into the land rental market in rural Korea.

6.3.1 Theories of the Demand for Land in a Competitive Rental Market

The basic assumption underlying the theory of a competitive land rental market is that contract rent is the price of the use of land determined by market factors. In the case of cropsharing tenancy, Bardhan and Srinivasan (1971) present a theoretical framework to identify relevant economic factors of market equilibrium. Assuming that the tenant is a utility maximizer, they show that the amount of land leased by a tenant is a decreasing function of the rental share. Currie rationalizes the rental market mechanism of fixed rent tenancy on the basis of a reservation price and limit price framework. As a utility
maximizer, a prospective tenant farmer would have a limit rent that is defined as the level of rent which would result in the same level of welfare he would enjoy if he did not enter into a tenancy contract. If there are many prospective tenants, this limit rent would constitute a market demand. The demand curve has also negative slope with respect to rent level.

Therefore, it is recognized that in a rental market, the rental rate, whether specified in terms of proportionate share of output or in terms of fixed payments, is a possible determinant of demand for lease land. However, the contract rent is not the only factor determining the amount of land leased by tenants. In deriving the demand function for lease land by sharecroppers, Bardhan and Srinivasan (1971) used the necessary conditions for interior maximum. These are directly related to labor productivity and land productivity. In Currie's presentation, the prospective tenant's limit rent also depends on the productivity of his labor relative to his opportunity cost. In brief, the contract rent, labor productivity, and land productivity are theoretically rationalized to be factors influencing the demand for land by tenant farmers under the assumption of a competitive rental market.
6.3.2 Factors Influencing Demand for Lease Land

In general, there must be a number of socio-economic factors explaining the amount of land leased in by tenant farmers. However, in this analysis, we will limit ourselves to considering only those variables which are theorized to be component in the context of the above competitive rental market assumption. A linear multiple regression model is specified as follows:

\[(6.5) \ TL = a + b1 RL + b2 LN + b3 KN\]

where \( TL \) = the physical units of tenanted land in pyung,
\( RL \) = the value of rent paid per unit of tenanted land in Korean won,
\( LN \) = the units of owned land per family member participating in farming, and
\( KN \) = the depreciation charges for equipment and building per family member.

The variable \( LN \) is selected because it is the inverse of man-land ratio, and the variable \( KN \) is used as a proxy variable for capital-man ratio. They are the variables related to the labor and land productivity.

The model was fitted to observations on 374 tenant farmers selected for allocative efficiency analysis in the previous section. The estimated function is

\[(6.6) \ TL = 1420.87 - 0.38 RL - 0.51 LN** + 0.02 KN** \]

\[(t\text{-ratio}) \ (-0.84) \ (-3.57) \ (3.09)\]
Generally, the signs for the three variables are as theoretically expected. The demand function is a decreasing function of the value of rent paid per unit of tenanted land. However, the coefficient of the rent variable is not significantly different from zero. Among the three independent variables, LN and KN have statistically significant coefficients. As a farmer has smaller amounts of owned land per family labor, he tends to borrow more land for tenancy. In addition, if a tenant has more capital equipment and building per family labor, he is capable of cultivating more leased land. The low R square of the model indicates that there are many variables dominating demand side decisions other than the above specified factors. However, our purpose is not to identify every possible variable explaining tenancy demand for land, but to inquire into the possible relationship between the expectations of theory and the actual situation of tenancy in Korea.

Rental market in rural Korea can also be illustrated in part by the trends in leased-in and leased-cut lands as seen in Table 6.5. The difference between leased-in and leased-out land may represent the land supplied by absentee-landlords. Supplies of lease land are provided by
absentee-landlords as well as farmers who live in rural area and operate only a part of their owned land. The both series indicate that there has been an increase in tenancy practices. However, the rate of change of each trend is distinctive. In the rental market, the growth rate of the amount supplied (leased-out) exceeds that of the amount of demanded (leased-in) in rental market. While leased-in land per farm has increased by 83 percent, from 260 pyung in 1965 to 475 pyung in 1981, leased-out land per farm has increased by 687 percent, from 15 pyung to 118 pyung in the same period. The ratio of the leased-in land to the leased-out land has reduced from 17.3 in 1965 to 4.0 in 1981.

These trends imply that, since 1965, the rental market for paddy land in Korea has been dominated by increasing land availability. This fact could, in a sense, explain why the estimated demand equation does not clearly reflect theoretical expectations. It seems that a supply-dominated rental market in Korea could not be stabilized at equilibrium.
TABLE 6.5  
Leased-In and Leased-Out Paddy Land per Farm, 1965-1981

<table>
<thead>
<tr>
<th>Year</th>
<th>Leased-In (A)</th>
<th>Leased-Out (B)</th>
<th>Ratio (A/B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td>260</td>
<td>15</td>
<td>17.3</td>
</tr>
<tr>
<td>1967</td>
<td>246</td>
<td>31</td>
<td>7.9</td>
</tr>
<tr>
<td>1969</td>
<td>318</td>
<td>28</td>
<td>11.4</td>
</tr>
<tr>
<td>1971</td>
<td>307</td>
<td>46</td>
<td>6.7</td>
</tr>
<tr>
<td>1973</td>
<td>286</td>
<td>50</td>
<td>5.7</td>
</tr>
<tr>
<td>1975</td>
<td>219</td>
<td>36</td>
<td>6.1</td>
</tr>
<tr>
<td>1977</td>
<td>305</td>
<td>57</td>
<td>5.4</td>
</tr>
<tr>
<td>1979</td>
<td>399</td>
<td>105</td>
<td>3.8</td>
</tr>
<tr>
<td>1981</td>
<td>475</td>
<td>118</td>
<td>4.0</td>
</tr>
</tbody>
</table>

6.3.3 **Summary**

In this section, the mechanism of competitive rental markets was reviewed. Theoretical frameworks suggest that rental demand for land should be a decreasing function of contract rent because rent is assumed to be the price for the use of land.

Theoretically defined variables, which include the rent paid per unit of rented land, the owned land per family labor, and the capital per family labor, were used to estimate a demand equation for leased land. In general, the estimated demand equation had a very low R square, which indicates that there are a number of factors determining the demand for leased land other than those specified in the model. The coefficient for the rate of rent appeared to be insignificant. The estimated parameters for two other variables were significant and had the expected signs. They indicate that rental demand for land tends to increase as capital per individual increases and tends to decrease as owned land per individual increases.

On the other hand, the characteristic of the rental market in rural Korea appears to be supply-dominated. From 1965 to 1981, the average growth rate of the land supplied was greater than that of the land demanded in rental market in Korea. This would be one of the reasons that the
estimated demand equation did not satisfy theoretical expectations based on the competitive rental market.
Chapter VII

CONCLUSIONS

The land law in Korea as it currently stands imposes two important restrictions on agricultural land use, one is a three hectare ceiling on land ownership and the other is a prohibition (with minor exceptions) on the practice of tenancy. Although strict enforcement of these restrictions have not been carried out, their economic effects on the transformation of the agricultural sector in the rapid growth of the overall economy have been matters of increasing policy concern. The question of whether or not these provisions in the law act as constraints on economic efficiency in agricultural production has been for some time an issue of debate among decision makers and scholars in support of different policy positions. Rice farming is the major agricultural sector of Korea consisting of almost 60 percent of the total cultivated land area. Thus, the purpose of this study was to settle as much of this issue as possible through the systematic analyses of changes in farm sizes and tenancy and their relations to economic efficiency in rice production.
The problem of farm size was examined in two contexts.

First, because the current farming structure, under land size provisions, does not allow a detailed investigation of economic efficiency of farm sizes larger than 3 hectares, the initial analysis was carried out primarily within the context of the existing 3 hectare farm size limitation.

Second, the expected economic efficiencies of farm sizes larger than 3 hectares were conceptualized under the hypothetical situation of NC legal restrictions on farm size. The viability of farms of various sizes, in terms of the level of agricultural income relative to that of urban household income, was also addressed.

Since the legal restrictions on tenancy are not strictly enforced, nonsanctioned tenancy practices are common. In relation to such tenancy practices, the analytical concern was on the efficiency of sharecropping tenants with respect to the utilization of variable inputs. Determinants of the demand for land by tenants were analyzed using competitive rental market theory, and the trends in demand and supply of leased land.
7.1 **SUMMARY OF MAJOR FINDINGS**

The relative economic efficiency concept and the economies-of-scale concept were employed in examining the economic efficiency of farm size. While the relative economic efficiency analysis compares each farm size class's average economic achievement, the economies-of-scale analysis investigates the 'frontier' achievements which are defined as the lowest production costs at various farm scales.

The relative economic efficiency of farm size classes was analyzed by estimating a profit function model using 1977 cross-section data on rice production costs. The results indicated that the economic efficiency of medium farms cultivating between 1 to 2 hectares was relatively higher than that of other farm sizes in rice production in 1977. Farms with more than 2 hectares of land size appeared to be equally as economically efficient as small farms cultivating less than 1 hectare. All farm size classes were able to satisfy marginal condition for profit maximization with respect to the use of hired labor.

A scatter diagram of cost-volume was used to draw short-run and long-run average cost curves for the analysis of the economies-of-scale in rice production. The proportional distribution of farms by size and the
efficiency index of average production cost were also examined. These were used to identify the best surviving farm size class. The results of these analyses were similar to the result produced by profit function analysis. This suggests that medium sized farms, 1 to 2 hectares, had higher economic efficiency than other farm sizes and were the optimal scale in the context of present land law. However, the possibility arises that, if the situation were to change and legal and technical constraints were removed, then the optimal farm scale may be larger than 3 hectares.

The adjustability of factor use over time was analyzed by farm size. Distributed lag models were estimated for labor, fertilizers, and chemicals with time-series rice production cost data from 1963 to 1981. The results show that Korean rice farmers have been able to adjust their variable inputs toward optimality fairly well. Estimated factor adjustment coefficients were greater than 0.6 for the three variable inputs. No significant differences were found among different farm size classes in the adjustment process.

The hypothetical situation without legal farm size limitation was also analyzed. A model was developed to explain why the farms presently cultivating more than 3 hectares would appear to be relatively economic-inefficient.
This model revealed that these farms are not necessarily inherently inefficient, but that the institutional barrier of farm size contributes to the inefficiencies of these farms. Also, the analysis of economies-of-scale using the presently available data may only represent the optimal scale at less than 3 hectares, since farm technology adaptable to Korean agriculture is characteristically labor intensive under the legal constraint of farm size. Thus, the result of this efficiency analysis must be considered conditional to the existing institutional situation.

The average income per farm from agricultural activities was not enough to cover farm living expenses in 1981. Farms cultivating less than 1.0 hectare, which comprise about two thirds of the total farm households in Korea, earned their agricultural income less than their living expenses. In addition, per capita agricultural income was, on the average, 66 percent of per capita urban household income and 45 percent of per capita GNP in 1981. Only farm size class larger than 2 hectares had per capita agricultural income greater than the average per capita urban household income. Nevertheless, the per capita income of this farm size class was still lower than per capita GNP in 1981.
In order to test the allocative efficiency of tenant farmers, the profit function and the hired labor demand function were jointly estimated for selected tenant farmers. Tenant farmers leasing lands more than 50 percent of the total cultivated paddy land showed that they maximized their own shares of total revenue, excluding rental payment, by equating their own shares of marginal value product of hired labor to the wage rate. Thus, for sharecropping, tenants were not as allocatively efficient as owner-cultivators in utilization of hired labor.

Although a rental market cannot be analyzed by a simple model, the demand side of rental market was examined based on the theoretical expectation of a competitive rental market. In theory, the rental demand for land should be a decreasing function of contract rent. A multiple regression equation was estimated including three explanatory variables: (1) rent paid per unit of tenanted land, (2) owned land per family labor, and (3) capital per family labor. In general, the estimated demand equation fitted to the selected tenant farms showed an insignificant coefficient for rental rate. However, the estimated coefficients of the other two variables had the right signs and were significant, indicating that rental demand for land tends to increase with higher capital-labor ratios and
decrease with higher land-man ratios. Trends in leased-in and leased-out paddy land in rural Korea since 1965 indicated that the rental market has been characterized by a growing supply. The growth rate of land supplied was greater than the land demanded in the rental market during the period of 1965-1981.

7.2 POLICY IMPLICATIONS

The analysis of the relationship between farm size classes and economic efficiency in the 1977 Korean rice farming revealed that the farm size class between 1 to 2 hectares was relatively of higher economic efficiency than the other farm size classes considered. A similar result was obtained from the analyses of economies-of-scale. Yet, the average land size of Korean farms is about 1 hectare and more than 65 percent of total farms cultivate less than 1 hectare (Table 5.4). This implies that even under the land size limitation of 3 hectares, there is a possibility of increasing farming efficiency by increasing the number of farms in the 1 to 2 hectare class. Meaningful policies regarding this possibility include increasing accessibility to the credit services for purchasing additional land and promoting cooperative farm organizations. To facilitate expansion of farm size, appropriate governmental policy can
also be sought in developing better agricultural infrastructure including land rearrangement and enlargement of irrigation and drainage projects.

The results of the analyses of farm size and economic efficiency, and the policy implications which can be drawn from these analyses, are valid only under the current land law limiting land ownership to 3 hectares. Thus, in policy deliberations concerning the relaxation or maintenance of land size limitation, other considerations must be taken into account. The severity of labor shortages, the adaptability of mechanized farm technologies, and the viability of farms must be regarded as crucial issues.

Since labor shortage is an important constraint in the farm size problem of rural Korea, the solution to the labor shortage problem would mean, in part, the solution to the farm size problem. If we assume that the current farm size limitation will continue, the solution to the labor shortage problem with farm mechanization can be sought through the cooperative use of farm machineries. This could lead to farm operations which can benefit from economies of scale.

If the three hectare size limitation is relaxed, then farm technology utilizing labor-saving machinery may result in an alternative economy of scale curve along which the optimal farm size might be beyond 3 hectares. The
significance of this hypothetical implication is related to the agricultural income level which defines the viability of farms in a growing economy. The viability of farms can be determined by the economic efficiency and the agricultural income per capita compared with the urban household income per capita.

Under the present situation in rural Korea, enforcement of legal provision on tenancy prohibition is not an effective policy. Rather, a legally sanctioned system of lease rentals is desirable. The supply-dominant characteristic of the rental market in rural Korea supports this implication. The situation is favorable to tenant farmers, and a traditional (semi-feudal) tenancy system would not be expected to occur.

However, the institutionalizing process will require well specified legal provisions for the protection of both landlord and tenant rights. Efficient resource allocation can be made through a well defined institutional system. Sharecropping results in less input utilization than the optimum level of resource allocation under owner cultivation. This sub-optimal level of resource allocation means, in turn, less agricultural production. Thus, on the basis of well designed institutionalized rental system, recommendable rental arrangements can be sought among the
forms of fixed-rent, cost sharing as well as output sharing, and input stipulated lease contracts. As Currie argues, recontracting sharecropping to one of the above contract forms would make both landlords and the tenants better-off. If efficient resource allocation can be realized under tenancy practices, farmers would more readily expand scale by leasing land.

7.3 DIRECTIONS FOR THE FURTHER RESEARCH

Empirical analysis of the relationship between farm size and economic efficiency was confined primarily to the farms under the legal constraints of 3 hectare ceiling. Although farms cultivating more than 3 hectares were considered, the analysis could not conclusively determine the full technical and economical capabilities of these larger farms. The potential increase in economic efficiency beyond the 3 hectare ceiling was implicitly found from the analysis of economies-of-scale. Therefore, further investigation of the technological change which is possible with large scale farm exceeding three hectares is recommended. This research can be conducted within the framework of experimentation since the farms currently cultivating more than 3 hectares are also influenced by the size limitation provision. Also, a research designed to
analyze other situations (e.g., international) which are not legally constrained by acreage ceilings and leasing restrictions might open up new perspectives.

The labor shortage problem, which is one of the key factors in farm size problem, must be studied in greater depth with regard to its effect on farming efficiency. The problematic concerns would include cost, timing, and final output and income levels in relation to the labor shortages. From this study, the expected change in the economic efficiency of different farming scales utilizing mechanized technology can be more clearly understood.

The farm size problem was examined only in the area of rice production. Farm adjustment processes including all crops can be further analyzed in order to provide broader relationship between farm size and economic efficiency.

Due to the data limitations, the forms of rental contracts could not be distinguished in analyzing allocative efficiency under tenancy. Further research on the problem of resource allocation under share tenancy can be performed by field surveys identifying the types of rental agreements being utilized. This would provide clearer empirical evidence of the allocative efficiency of tenant farmers according to different types of rental arrangements. This study was concerned with only tenant farmers' allocative
efficiency. However, the resource conservation practices of tenant farmers should be further considered.

Since the major factors determining rental demand for land could not be realistically identified among the variables in the available data set, further work is also needed in this direction. More detailed analysis can be accomplished if one were to search for socio-economic factors influencing the lease rental situation in rural Korea. The field survey method would be useful for this purpose. The motivations of both leasing in and leasing out lands should be investigated at the same time.
Appendix A

ARGUMENTS ON SHARE TENANCY AND ALLOCATIVE EFFICIENCY

A.1 TAX-EQUIVALENT ARGUMENT

This argument draws a parallel between contract rent and tax rates. When a lump-sum tax, within the relevant range, is levied on a business firm, it does not affect output because it only reduces entrepreneur's profit or reward from the business. However, when a tax is determined as a certain proportion of output, the entrepreneur will adjust output level because he will try to equate the value of marginal product (after tax) to the marginal cost of input. In tenancy contract, a fixed rent is equivalent to a lump-sum tax to a tenant, and a cropsharing rent is equivalent to a tax determined as a proportion of output.

This argument is expressed in an explicit model. Suppose that a well behaved production function is represented by

\[ (A.1) \quad V = V(L, N) \]

where \( V \) is output, \( L \) is units of land, and \( N \) is units of labor. A net revenue function can be defined as

\[ (A.2) \quad \pi = PV - wN - rPV \]
where $P$ is price of output, $w$ wage rate, and $r$ the proportional (sharecropping) rate, with $0 < r < 1$.

The maximization of the net income requires the following conditions, i.e.,

\[(A.3) \frac{\partial \pi}{\partial N} = P \frac{\partial V}{\partial N} - w - rP \frac{\partial V}{\partial N} = 0\]

Thus,

\[(A.4) w = (1 - r)P \frac{\partial V}{\partial N}\]

Equation (A.4) shows that tenant's labor will be utilized until his share of marginal value product of labor equals the wage rate. Thus, a reduction in $r$ would result in more labor use on a given input of land.

If a rent is set at a fixed amount on a given unit of land, the model will be expressed as follows. Let tenant's net revenue function be

\[(A.5) \pi' = PV - wN - F\]

where $F$ is the amount of fixed rent. The net revenue maximization condition will be

\[(A.6) \frac{\partial \pi'}{\partial N} = P \frac{\partial V}{\partial N} - w = 0\]

Therefore, if rent should be a fixed sum, then the wage rate will simply be equated to the marginal value product of labor. Consequently, tenants on a fixed rent contract will
utilize inputs as owner cultivators, whereas sharecropping tenants will use less inputs.

A.2 CHEUNG'S COMPETITIVE MARKET ARGUMENT

In Cheung's (1969a) argument, landlords are assumed to be contract rent maximizers subject to constraints of market wage rate of tenant labor and the agricultural production function. This assumption requires that the set of constraints for decision making by landlords be invariant with respect to rents under sharecropping versus fixed sum contract. Thus, there is only one maximum total rent which results in the same resource use whatever the rental contract is.

Cheung presents this argument by formulating the following mathematical model. Assume that there are two homogeneous factors of production, \( l \) and \( N \), where \( l \) is the amount of land per tenant farm and \( N \) is the amount of tenant labor per farm. Let

\begin{equation}
V = V(l, N)
\end{equation}

be the production function of a tenant farm. \( l \) equals \( L/M \): that is, total landholding of landlord, \( L \), divided by the number of tenant farms, \( M \). Then the landlord earns rent income as much as

\begin{equation}
I = MrPV
\end{equation}
where \( r \) is the proportional rent, and \( P \) is the price of output. Under the assumption of a competitive market, labor share will be

\[(A.9) \ w_N = (1 - r)P \]

Then the landlord will maximize I subject to the constraint \((A.9)\). The Lagrangean expression specifies the maximization problem as

\[(A.10) \ H = M_r PV - \lambda (w_N - (1 - r)PV) \]

where \( \lambda \) is Lagrangean multiplier. Take the partial derivative of the expression with respect to \( M, r, N, \) and \( \lambda \) to get the necessary conditions.

\[(A.11) \ \frac{\partial H}{\partial M} = rPV + M_r P \frac{\partial V}{\partial M} + \lambda (1 - r) \frac{\partial V}{\partial M} = 0 \]

\[(A.12) \ \frac{\partial H}{\partial r} = MPV - \lambda PV = 0 \]

\[(A.13) \ \frac{\partial H}{\partial N} = M_r P \frac{\partial V}{\partial N} - \lambda w + \lambda (1 - r)P \frac{\partial V}{\partial N} = 0 \]

\[(A.14) \ \frac{\partial H}{\partial \lambda} = -(w_N - (1 - r)PV) = 0 \]

Again, equation \((A.11)\) becomes

\[(A.15) \ rPV - 1P \frac{\partial V}{\partial l} = 0 \quad \text{or} \quad \frac{rV}{1} = \frac{\partial V}{\partial l} \]

Equation \((A.13)\) becomes
Equation (A.16) indicates that the rent per unit of land in physical terms equals the marginal product of land, and equation (A.17) indicates that the marginal value product of tenant labor equals the wage rate. The conditions are identical to those of a fixed-rent contracts. The underlying assumption in achieving this result is that landlord decides not only the rate of proportional rent and the units of land to be rented out to each tenant but the amount of labor to be provided by the tenant.
Appendix B

SYSTEMS OF SEEMINGLY UNRELATED EQUATIONS

The seemingly unrelated-equation model consists of a series of equations which are related through correlations in the error terms across different equations. An example of such a model is

(B.1) \[ Y_1 = a_0 + a_1 X_1 + a_2 X_2 + u_1 \]
(B.2) \[ Y_2 = b_0 + b_1 X_3 + b_2 X_4 + u_2 \]
(B.3) \[ Y_3 = c_0 + c_1 X_5 + c_2 X_6 + u_3 \]

This form might be used when one is estimating a set of demand equations for related products.

If the disturbances of each equation are unrelated, then there is indeed no relationship between the equations because the set of explanatory variables is not identical for each equation. In such a case, ordinary least-squares estimation is appropriate. If there are non-zero correlation between the disturbance terms in two or more equations, then efficient estimates can be obtained using a more sophisticated estimation method. This method is proposed by Zellner, which is called Seemingly Unrelated Regression model using a system method of estimation.
Assume that one is attempting to predict the percentage shares of household budget to be allocated to three purposes. Then the percentage share of each consumption purpose is $Y_i$ ($i=1,2,3$) as seen in equations (B.1), (B.2), and (B.3). When none of the dependent variables appears on the right-hand side of any equation, the seemingly unrelated-equation model is appropriate. The correlation arises because of the restriction that the sum of the shares of consumption expenditure is 100 percent. If expenditures for one or two purposes are predicted to be higher than average, then residual item should be predicted to be lower than average. This correlation can be seen more clearly by summing up each of the three equations:

$$1 = Y_1 + Y_2 + Y_3$$
$$= (a_0 + b_0 + c_0) + a_1 X_1 + a_2 X_2 + b_1 X_3 + b_2 X_4 + c_1 X_5 + c_2 X_6 + (u_1 + u_2 + u_3)$$

Since equation (B.4) must hold identically, it requires that $u_1 + u_2 + u_3 = 0$.

The above model could be estimated by using independent ordinary least-squares method for each equation to obtain consistent and unbiased parameter estimates. However, the efficiency of the parameter estimates could be improved through the use of generalized least-squares estimation: i.e., Zellner estimation (for details of the estimation method, refer to Johnston 1972, pp. 238-241; Pindyck and Rubinfeld, pp. 347-349; and Zellner, pp. 348-368).
Appendix C

THE POSSIBILITY OF SECURING MUTUAL GAINS FROM SWITCHING TO A DIFFERENT FORM OF SHARE CONTRACT

C.1 UNDER THE ASSUMPTION OF PERFECT KNOWLEDGE

C.1.1 The Contract of Sharing Costs as well as Revenue

When a new contract is agreed upon sharing costs as well as revenue, it will stipulate that the tenant pay the landlord

\[ r^*(Z(N) - WN) \]

where \( r^* \) is new rental share, \( Z(N) \) revenue function, \( w \) wage rate, and \( N \) labor input. Irrespective of the level of the new rental share, the tenant would respond by maximizing his own share of total revenue. However, the necessary condition for the maximization of tenant's share will become

\[ \text{MVP}(N) = w \]

where \( \text{MVP}(N) \) is the marginal value product of labor. The tenant will utilize his labor input to the same level as owner operators do. Thus, the labor input will be used up to \( N^* \) in Figure 3.3.

Now we may prove that there exists a set of rental shares which would lead to mutual gains. Let \( r^1 \) be the new share which would leave the landlord unaffected: that is
\[(C.3) \quad r_1(Z(N*) - wN) = rZ(N)\]

so that

\[(C.4) \quad r_1 = \frac{rZ(N)}{Z(N*) - wN*}\]

where \(r\) and \(N\) are the rental share and the level of labor input, respectively, under the contract for sharing revenue only. Here the landlord would be better off at any rental share above \(r_1\).

Let \(r_2\) be the new share which would leave the tenant unaffected: that is,

\[(C.5) \quad (1 - r_2)(Z(N*) - wN*) = (1 - r)Z(N) - wN\]

so,

\[(C.6) \quad r_2 = \frac{rZ(N)}{(Z(N*) - wN*)} + \frac{(Z(N*) - wN*) - (Z(N) - wN)}{(Z(N*) - wN*)}\]

At any rental share below \(r_2\), the tenant would be better off. Since \((Z(N*) - wN*) > (Z(N) - wN)\), it follows that \(r_2 > r_1\). Thus, there exists a set of rental share which would yield mutual gains. Specifically both would gain provided that \(r_1 < r* < r_2\). The \(r*\) will be dependent upon the bargaining power of each party.
C.1.2 **A Share Contract Which Stipulates the Levels of Tenant Input**

Let \( r_1 \) be the new share which would leave the landlord unaffected: that is,

\[ (C.7) \quad r_1 z(N^*) = r_2 z(N) \]

so that

\[ (C.8) \quad r_1 = \frac{r_2 z(N)}{z(N^*)} \]

At any rental share above \( r_1 \), the landlord would be better off.

Let \( r_2 \) be the share which would leave the tenant unaffected: that is,

\[ (C.9) \quad (1 - r_2) z(N^*) - wN^* = (1 - r) z(N) - wN \]

\[ (C.10) \quad r_2 = \frac{r_2 z(N)}{z(N^*)} + \frac{(z(N^*) - wN^*) - (z(N) - wN)}{z(N^*)} \]

Since \((z(N^*) - wN^*) > (z(N) - wN)\), \( r_2 > r_1 \). There exists a set of rental share which would yield mutual gains provided that the rental share, \( r^* \), would be set within the range \( r_1 < r^* < r_2 \).
C.2 **UNDER THE ASSUMPTION OF UNCERTAINTY**

If we assume that there exists uncertainty, with respect to either prices or yields, the analysis is considerably more complicated than the case of certainty. However, there exists the possibility of prospective mutual gains even in that case. That is the share-rental contract which stipulates the levels of tenant input. This can be compared with the fixed rent contract.

Assume that the tenant is averse to risk and the landlord is indifferent to risk. Under the fixed rent contract, the tenant's terminal financial wealth would be

(C.11) \[ W = Z - R \]

where \( R \) is the fixed rent. The expected value of his wealth is

(C.12) \[ E(W) = E(Z) - R \]

Suppose they switch to a share-rental contract which stipulates the level of tenant input. If the new agreement leaves the landlord's ex ante welfare unaffected, the tenant's terminal wealth would be

(C.13) \[ W' = Z - r'Z \]

with an expected value

(C.14) \[ E(W') = E(Z) - r'E(Z) = E(Z) - R \]

where \( r' \) is the share-rental rate under the new contract which would yield an expected rent equal to the fixed rent.
under the previous contract. This recontract would leave
the tenant's expected wealth unaffected: that is, \( E(W') = E(W) \) since \( r'E(Z) = R \). However, from this point of view,
the situation under share tenancy would be less risky. Of
the two subjective probability density functions for wealth,
the one under the fixed rent tenancy would be more stretched
around the mean. Since, by assumption, the tenant is averse
to risk, his utility of terminal wealth would be higher
under the share tenancy which stipulates the use of tenant's
input. He would benefit from the recontract. Thus, the
rental share which would leave the tenant's ex ante utility
unchanged would be strictly greater than \( r' \). A switch to
any share between these two extremes would benefit both
parties.
Appendix D
SUPPLEMENTARY TABLES AND FIGURE

TABLE D.1
Average Production Cost\(^a\) per 80 kg of Hulled Rice Grain
by Farm Size, 1967-1981

<table>
<thead>
<tr>
<th>Year</th>
<th>Less than 0.5 ha</th>
<th>0.5 - 1.0 ha</th>
<th>1.0 - 1.5 ha</th>
<th>1.5 - 2.0 ha</th>
<th>2.0 ha and over</th>
</tr>
</thead>
<tbody>
<tr>
<td>1967</td>
<td>2,701</td>
<td>2,852</td>
<td>2,661</td>
<td>2,755</td>
<td>2,696</td>
</tr>
<tr>
<td>1968</td>
<td>3,603</td>
<td>3,721</td>
<td>3,274</td>
<td>3,351</td>
<td>3,219</td>
</tr>
<tr>
<td>1969</td>
<td>3,691</td>
<td>3,681</td>
<td>3,475</td>
<td>3,487</td>
<td>3,551</td>
</tr>
<tr>
<td>1970</td>
<td>5,075</td>
<td>4,698</td>
<td>4,514</td>
<td>4,559</td>
<td>4,650</td>
</tr>
<tr>
<td>1971</td>
<td>4,772</td>
<td>4,758</td>
<td>4,591</td>
<td>4,724</td>
<td>4,633</td>
</tr>
<tr>
<td>1972</td>
<td>7,165</td>
<td>6,275</td>
<td>5,843</td>
<td>6,150</td>
<td>5,870</td>
</tr>
<tr>
<td>1973</td>
<td>7,280</td>
<td>6,929</td>
<td>6,551</td>
<td>6,571</td>
<td>5,984</td>
</tr>
<tr>
<td>1974</td>
<td>9,550</td>
<td>9,038</td>
<td>8,825</td>
<td>8,463</td>
<td>7,924</td>
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<tr>
<td>1975</td>
<td>13,598</td>
<td>12,413</td>
<td>12,308</td>
<td>12,271</td>
<td>12,305</td>
</tr>
<tr>
<td>1976</td>
<td>14,629</td>
<td>15,919</td>
<td>13,633</td>
<td>13,871</td>
<td>13,795</td>
</tr>
<tr>
<td>1977</td>
<td>17,046</td>
<td>15,695</td>
<td>15,186</td>
<td>14,848</td>
<td>15,042</td>
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<tr>
<td>1978</td>
<td>21,168</td>
<td>20,328</td>
<td>20,259</td>
<td>20,228</td>
<td>21,809</td>
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<tr>
<td>1979</td>
<td>26,252</td>
<td>24,999</td>
<td>25,048</td>
<td>24,949</td>
<td>23,960</td>
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<tr>
<td>1980</td>
<td>42,945</td>
<td>40,390</td>
<td>40,905</td>
<td>40,737</td>
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<td>1981</td>
<td>37,893</td>
<td>35,636</td>
<td>35,996</td>
<td>35,603</td>
<td>36,467</td>
</tr>
</tbody>
</table>

Note: \(^a\)Value of by-product is subtracted from the production cost.


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TABLE D.2
Estimated Equation of Partial Adjustment Model for Labor in Rice Production by Farm Size

<table>
<thead>
<tr>
<th>Parameters&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Farm Class Size</th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Less than 1.0 ha</td>
<td>1.0 - 2.0 ha</td>
<td>2.0 ha and over</td>
</tr>
<tr>
<td>a'</td>
<td>0.1573&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.1341</td>
<td>0.1614</td>
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<tr>
<td></td>
<td>(3.7164)</td>
<td>(3.8486)</td>
<td>(3.8579)</td>
</tr>
<tr>
<td>d1</td>
<td>-0.0021</td>
<td>-0.0026</td>
<td>0.0000</td>
</tr>
<tr>
<td></td>
<td>(-0.1943)</td>
<td>(-0.2532)</td>
<td>(0.0012)</td>
</tr>
<tr>
<td>d2</td>
<td>0.0143</td>
<td>0.0021</td>
<td>0.0135</td>
</tr>
<tr>
<td></td>
<td>(0.9909)</td>
<td>(0.1780)</td>
<td>(1.2162)</td>
</tr>
<tr>
<td>d3</td>
<td>-0.0059</td>
<td>-0.0128</td>
<td>-0.0195</td>
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<tr>
<td></td>
<td>(-0.4683)</td>
<td>(-1.1304)</td>
<td>(-2.0654)</td>
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<tr>
<td>d4</td>
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<td>-0.0436</td>
<td>-0.0534</td>
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<tr>
<td></td>
<td>(-3.5373)</td>
<td>(-3.9562)</td>
<td>(-4.8272)</td>
</tr>
<tr>
<td>b</td>
<td>0.3085</td>
<td>0.3939</td>
<td>0.1959</td>
</tr>
<tr>
<td></td>
<td>(1.4727)</td>
<td>(2.1426)</td>
<td>(1.0607)</td>
</tr>
<tr>
<td>R&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.5250</td>
<td>0.5144</td>
<td>0.6905</td>
</tr>
</tbody>
</table>

Note: <sup>a</sup>For the model specification, see Section 5.3.
<sup>b</sup>Numbers in Parentheses are asymptotic t-ratios.
TABLE D.3
Estimated Equations of Partial Adjustment Model for Fertilizer in Rice Production by Farm Size

<table>
<thead>
<tr>
<th>Parameters&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Farm Size Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Less than 1.0 ha</td>
</tr>
<tr>
<td>a'</td>
<td>0.0206</td>
</tr>
<tr>
<td></td>
<td>(4.0405)</td>
</tr>
<tr>
<td>d1</td>
<td>0.0188</td>
</tr>
<tr>
<td></td>
<td>(5.1577)</td>
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<tr>
<td>d2</td>
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</tr>
<tr>
<td></td>
<td>(0.5680)</td>
</tr>
<tr>
<td>d3</td>
<td>-0.0073</td>
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<tr>
<td></td>
<td>(-2.0475)</td>
</tr>
<tr>
<td>d4</td>
<td>0.0073</td>
</tr>
<tr>
<td></td>
<td>(2.2382)</td>
</tr>
<tr>
<td>b</td>
<td>0.3344</td>
</tr>
<tr>
<td></td>
<td>(2.4271)</td>
</tr>
<tr>
<td>R²</td>
<td>0.7764</td>
</tr>
</tbody>
</table>

Note: <sup>a</sup>For the model specification, see Section 5.3.

<sup>b</sup>Numbers in Parentheses are asymptotic t-ratios.
TABLE D.4

Estimated Equations of Partial Adjustment Model for Agricultural Chemicals in Rice Production by Farm Size

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Farm Size Class</th>
<th>Less than 1.0 ha</th>
<th>1.0 ha - 2.0 ha</th>
<th>2.0 ha and over</th>
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</thead>
<tbody>
<tr>
<td>a&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td>0.0157</td>
<td>0.0157</td>
<td>0.0158</td>
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<td></td>
<td></td>
<td>(4.1540)</td>
<td>(4.0031)</td>
<td>(4.4454)</td>
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<td>d1</td>
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<td>-0.0075</td>
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<td></td>
<td>(-3.5620)</td>
<td>(-3.4349)</td>
<td>(-3.7916)</td>
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<td>-0.0051</td>
<td>-0.0053</td>
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<td></td>
<td>(-3.3252)</td>
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<td>(-3.3322)</td>
</tr>
<tr>
<td>d3</td>
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<td>-0.0051</td>
<td>-0.0053</td>
</tr>
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<td>(1.7385)</td>
<td>(1.4346)</td>
<td></td>
</tr>
<tr>
<td>R&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td>0.8415</td>
<td>0.7931</td>
<td>0.7745</td>
</tr>
</tbody>
</table>

Note: <sup>a</sup> For the model specification, see Section 5.3.
<sup>b</sup> Numbers in Parentheses are asymptotic t-ratios.
Figure D.1: Cost-Volume Scatter Diagram in Rice Production
BIBLIOGRAPHY


