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The Asian Path of Agricultural Development: Patterns of Development of Structural Input-Output Relationships

Cid Terosa [a], Katsuhiko Demura [b], Akio Ito [c]

[a] *School of Economics, University of Asia and the Pacific, Pasig City, Manila, Philippines*
[b] *Department of Agricultural Economics, Hokkaido University, Sapporo City, Japan*
[c] *Faculty of Commerce, Hokkaigakuen Kitami University, Kitami, Hokkaido, Japan*

1. Introduction

Agricultural transformation is generally characterized by the decrease in the share of agriculture in the production and employment structures of the economy, rapid agricultural growth, and improved technological and institutional structures. The transformation of agriculture from a traditional into a modern sector occurs together with significant structural changes and output growth in the entire economy.

As agricultural incomes rise and demand for industrial products increase, the structure of production and employment substantially shifts away from agriculture to industry. This structural shift influences the transformation of traditional agriculture by enabling farmers to acquire more inputs from nonagricultural industries and by creating greater demand for off-farm services such as transportation, storage, handling, and processing.

Thus, agricultural transformation does not only entail increases in agricultural output and improvements in the technological and institutional framework of the agricultural sector, but it also involves greater integration and interdependence with the rest of the sectors of the economy. The objective of this paper is to investigate empirically the changes in the agricultural interindustry relationships that accompanied agricultural transformation in countries that follow the Asian path of agricultural development (Hayami and Ruttan 1985, pp. 118-133), particularly Japan, Korea, Taiwan, and the Philippines.

The Asian path of agricultural development is characterized by a rapidly growing population and limited land. An essential feature of the Asian path is the development, adoption, and propagation of biological and chemical technologies to overcome impediments imposed by land and population. although Asian countries like Japan, Taiwan, Korea, and the Philippines tread on the same path of agricultural development, their level of economic development, economic structures, resource endowments, and agricultural features differ significantly. The manifestations of the similarities and differences in their movement within the Asian path is therefore of utmost interest.

The trend of land and labor productivity has been customarily used to describe the Asian path. The analysis of factors other than land and labor productivity that shape the Asian path serve to broaden the universal aspects of this path. The interindustry aspect is one such overlooked factor.[1] The unconscious disregard and paucity of discussions on the importance of interindustry relationships are not only evident in productivity-related studies, but also in discussions of agriculture's contributions to economic development.

Interindustry relationships are the means by which the expansion of agricultural production through domestic demand, technological change, and trade stimulate the production of important agricultural input requirements such as seeds, machinery, fertilizers, transportation facilities, commercial and financial services, and construction. Thus, production interdependencies represent one force behind the movement of countries within the Asian path of agricultural development. The existence of uniform

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[1] Ghatak and Ingersent (1984) are one of the few who have explicitly discussed the interindustry aspects of the role of agriculture in economic development.

or divergent patterns of change in structural interindustry or input-output relationships in the process of agricultural transformation within the Asian path clearly deserves scrutiny.

Specifically, the research will seek to identify patterns of development in the production generation and adjustment mechanisms of agriculture in Japan, Taiwan, Korea, and the Philippines from 1960-1985.[2] The production adjustment mechanism of agriculture refers to the interindustry process through which agriculture satisfies exogenous changes in final demand for its products. Thus, changes in the production adjustment mechanism of agriculture helps determine changes in the interindustry transactions efficiency of agriculture. On the other hand, the production generation mechanism refers to the process through which the multiplier effects of exogenous change in agriculture is felt throughout the economy. Changes in the production generation mechanism of agriculture therefore provide insights into the influence of agricultural interindustry production relationships on the impact effects of exogenous changes in agriculture.

Input-output analysis will be used to determine the changes in agricultural interindustry production relationships that are attendant to agricultural transformation. A detailed explanation of the input-output approaches utilized to analyze the patterns of development in the production generation and adjustment mechanisms of agriculture through time is given in Section 2. A brief discussion of the indicator used to determine the relative level of agricultural transformation in Japan, Korea, Taiwan, and the Philippines from 1960-1985 and an enumeration of the data used in this study are also presented in Section 2. The empirical results are analyzed in Section 3. Section 4 provides a summary of the major empirical results and conclusions of the study.

2. Methodology

2.1 Sequential Input-Output Model

The impact of an exogenous change in one particular sector on all the sectors of the economy is traditionally studied using the Leontief inverse matrix. Mules (1983) argued, however, that the Leontief domestic inverse matrix does not take into account the length of time needed to realize effects. He contended that the absence of a time framework seriously limits the usefulness of the input-output multiplier for impact analysis. In order to identify the delayed responses to an initial impact, Mules (1983) decomposed the usual input-output multiplier and presented a system of modeling input-output responses to an initial impact without recourse to the Leontief inverse. This system is called the sequential input-output model.

The sequential input-output model is essentially based on the power series expansion of the Leontief inverse.[3] Therefore, it relies on the direct input or technical coefficients to trace production responses. The power series $I + A + A^2 + A^3 + ... + A^n$ implies that A, A^2, A^3, A^n are the first, second, third, and nth responses to the initial impact. Denoting the first response by S_1, one can derive the second response or second round effect by premultiplying the direct input coefficient matrix A to S_1. This means that in order to produce the amounts required in the first round effect, sectors must purchase inputs. The second round effect AS_1 is therefore the response to the first round effect, and the third round effect is the response to the second round effect, and so on. Thus,

$S_2 = AS_1$ (second response or round effect)

$S_3 = AS_2$

[2] Korea refers to South Korea. The research was limited to the period 1960-1985 because at the time the research was conducted the latest (post-1985) input-output tables for Korea and Taiwan were unavailable. The period 1960-1985 was chosen because it represents a high growth period for Japan, Taiwan, and Korea. This was the period when the three countries were able to achieve agricultural transformation.

[3] For a straightforward explanation of the power series inversion of the Leontief matrix, see Ronald Miller and Peter D. Blair, Input-Output Analysis: Foundations and Extensions (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1985), 22-24.

$S_3 = A\,(AS_1)$ (third response or round effect)

...

$$S_n = A^{n-1} S_1 \qquad (1)$$

where S_n is the nth round response or round effect and A is the global direct input coefficient matrix.

The sum of $S_1 + S_2 + ... + S_n$ is equal to the multiplier effect obtained using the Leontief inverse. In this formulation it is assumed that the each sector can respond immediately to the needs of the previous period without delay. This, however, is not the case in the real world because production lags are almost always imminent.

Assuming that the lags in production response for each sector have been determined, the first round effect in a sequential input-output system can be written as

$$S_1 = I_0\, A\, S_0$$

where I_0 is the lag operator matrix, A is the global direct input coefficient, and S_0 is the final demand vector representing the initial exogenous impact.

The lag operator's diagonal elements can either be one or zero, while its off-diagonal elements are all zeros. If a sector can respond to the impact in the particular round in question, the corresponding diagonal element of the lag operator matrix is given a value of one. Otherwise, the value of the diagonal element remains zero. The lag operator I_0 therefore identifies those sectors with no production lags, I_1 those sectors with a lag period of one, I_2 those sectors with a lag period of two, and so on. On the other hand, S_0 is a column vector composed of zeros except for the sector or sectors that exhibit an exogenous change in final demand.

The second round effect is therefore the sum of the responses of those sectors with a lag period of one to the initial impact and the responses of those sectors with no production lags to the first round effect, the third round effect is the sum of the responses of those sector with a lag period of two to the initial impact, the responses of those sectors with a lag period of one to the first round effect, and the responses of those sectors with no production lags to the second round effect, and so on. Thus,

$$S_2 = I_0\, A\, S_1 + I_0\, A\, S_0$$
$$S_3 = I_0\, A\, S_2 + I_0\, A\, S_1 + I_0\, A\, S_0\,.$$

The effect for any round can therefore be written as

$$S_n = \sum_{k-1}^{n} I_{k-1}\, A\, S_{n-k} \qquad (2)$$

where I_{k-1} is the lag operator matrix for k-1 periods and S_{n-k} is the lag operator for n-k periods. Equation 2 is the matrix formulation of the sequential input-output model. The model helps determine the length of time required for a substantial portion of the impact effects of exogenous changes in agriculture to be felt throughout the economy.

2.2 Robinson-Markandya Quantity Adjustment Model

Ideally, the lag operator matrixes used in the sequential input-output model should be constructed based on production data.[4] In the absence of detailed production data on the period required between

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[4] The sequential input-output model has sometimes been criticized as a mere "re-arrangement" of impact effects; thus, the sequential effects generated from the model are considered arbitrary. The determination of the lags using production data, however, is meant to establish the empirical nature of the sequential effects.

production and delivery to final demand, lag operators were arrived at by using an input-output model developed by Robinson and Markandya (1973), which offers an empirical way of delineating structural complexity and adjustment mechanisms and suggests concepts related to the determination of interindustry transactions efficiency. The determination of the production lag within an interindustry framework is ideal because it is consistent with the formulation of the sequential input-output model.

The assumptions of the Robinson-Markandya Quantity Adjustment Model implies that the sectors in the economy produce output according to the power series expansion of the inverse.[5] This means that the economy produces output in this manner:

$$X = (I - <U> A)^{-1} Y$$

$$X = \lim_{n \to \infty} (I + <U> A + (<U>) A^2 + ... + (<U>) A^n) Y \qquad (3)$$

where X is total output, <U> is the diagonalized rate of self-sufficiency[6] matrix, A is the direct input coefficient matrix, Y is final demand, and $(I-<U>A)^{-1}$ is the Leontief domestic inverse matrix. Since the Leontief domestic inverse matrix is used, Y is equal to $(<U>D + E)$, where D is domestic final demand and E is exports.[7]

As shown by equation 3, the Robinson-Markandya Quantity Adjustment Model used in this study utilizes the Leontief domestic inverse matrix[8], which is unlike the original formulation of the model. The use of the Leontief domestic inverse matrix allows for the consideration of the effect of the change in the rate of self-sufficiency on the number of production rounds needed by a sector to satisfy an exogenous change in final demand. Generally, the number of production rounds decreases with an increase in the rate of self-sufficiency, and vice-versa. The increase in the rate of self-sufficiency implies that domestic production has increased relative to imports. Thus, final demand requirements can be met immediately with domestically produced output. Some exceptions to this rule, however, may be observed. In this case, the number of production rounds may be affected by changes in technological interdependence.

From Equation 3, it is clear that in the first production round, Y is produced and the sectors order $(<U>A)Y$ of inputs. In the second production round, $(<U>A)Y$ is produced and $(<U>A)^2 Y$ is ordered and so on. This series continue until each sector has reached a cut-off point or a certain percentage of total output. Robinson and Markandya (1973) suggested the use of official data to determine the cut-off point. In this study, however, the agricultural and food manufacturing sectors were made arbitrarily to finish production after they have achieved ninety-eight percent of total output. All the other sectors were made to finish production after they have achieved ninety-five percent of total output. Agriculture and food manufacturing were made to produce a greater percentage of output since food and food-related products are basic necessities.

The imposition of the cut-off point denotes that the power series inversion of the matrix can be written as

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[5] See Robinson and Markandya's (1973) paper for a detailed explanation of their model's assumptions.

[6] The rate of self-sufficiency is computed as the difference between 1 and the import coefficient. The import coefficient is the ratio of total imports to the sum of total intermediate demand and total domestic demand. All the values used in the computation of the import coefficient are taken from the input-output table.

[7] For an explanation of this type of inverse matrix, see Victor Bulmer Thomas, Input-Output Analysis in Developing Countries (New York: John Wiley and Sons Ltd., 1982), 238-241.

[8] The Robinson and Markandya (1973)study used the global Leontief inverse matrix, $(I-A)^{-1}$. This implies that Robinson and Markandya did not consider the effects of trade on their model, i.e. they assumed autarky.

$$X(i) = (I + \langle U \rangle A^{(1)} + \langle U \rangle A^{(2)} \langle U \rangle A^{(1)} + \ldots + \langle U \rangle A^{n} \langle U \rangle A^{(n-1)} \langle U \rangle A^{(1)}) Y \qquad (4)$$

Equation 4 is the specification of the Robinson-Markandya Quantity Adjustment Model used in this study.

In Equation 4, $\langle U \rangle A^{(1)}$ is equal to <U>A. $\langle U \rangle A^{(2)}$ is also equal to <U>A, but the elements in the columns of <U>A for those sectors that finished production in the previous round is set to zero. For example, if a certain sector finishes production in round 3, then that industry produces up to round 4. After round 4, its column elements are set to zero. The number of production rounds for this sector is therefore equal to 3. One should note that the term production rounds refers to the length of time between making the production decision and actually producing the output.[9]

Robinson and Markandya (1973) implied that a production round indicates a constant adjustment or transactions cost. They opined that the greater the number of production rounds a sector takes to complete the required production, the less transactions cost efficient the sector becomes, and vice-versa. The model therefore equates interindustry efficiency with fewer production rounds. Based on equation 4, the number of production rounds a sector takes to complete the required production depends on its technological structure as described by the direct input coefficients and on the rates of self-sufficiency of all the sectors in the economy.

2.3 Data

The study used six input-output tables each for Japan, Korea, Taiwan, and the Philippines. The input-output tables used in this study and their sources are listed down in Table 1. All the input-output tables used in this study are in competitive imports form and valued at current producers' prices.

The input -output tables were made comparable to each other and aggregated into sixteen sectors. Since the analysis centers on the interindustry agricultural transformation process, agriculture was disaggregated into three sectors, namely, agricultural crops, livestock, and agricultural services. Agricultural crops include grains, fruits and vegetables, and industrial crops. On the other hand, livestock covers hogs, cattle, and other livestock and livestock products, while agricultural services include veterinary and other agricultural services. In the analysis, however, only the results for agricultural crops and livestock are presented since they form a substantial portion of the agricultural sector in any of the countries studied. The sectoral classification used in this study is shown in Table 2.

2.4 Relative Degree of Agricultural Transformation

In this study, the relative degree of agricultural transformation was determined based on changes in the share of agriculture in the employment structure, one of the main features of the agricultural transformation process identified by Timmer (1988). The use of the change in the share of agricultural employment as indicator of the level of agricultural transformation is similar to the transition concept favored by Oshima (1989) in his analysis of economic growth in monsoon Asia.

Based on the criteria set by Timmer (1988) and the transition concept of Oshima (1989), a country is deemed to have a higher relative degree of agricultural transformation if the share of its agricultural employment is less than the other country, and vice-versa. As shown in Table 3, Japan has the highest relative degree of transformation, followed by Taiwan, Korea, and the Philippines. The common and peculiar patterns of development in the production generation and adjustment mechanisms of agriculture through time will therefore be interpreted based on these relative degrees of agricultural transformation.

3. Empirical Analysis and Results

3.1 Production Adjustment Mechanism and Interindustry Transactions Efficiency

Equation 4 was used to analyze changes in the interindustry production adjustment mechanism of agriculture through time and to determine the lag operators for the sequential input-output analysis. As

[9] Robinson and Markandya (1973) refer to this length of time as a month.

shown in Table 4, the number of production rounds required by agricultural crops and livestock to meet final demand increased through time in Taiwan, Korea, and the Philippines, but not in Japan. The result obtained for Japan implies that at a relatively higher level of agricultural transformation, the agricultural sector tends to be interindustry transactions efficient.

The peculiar pattern exhibited by Japan can be explained by the improvement in the rate of self-sufficiency of its agricultural sector. As can be observed from Table 5, the rate of self-sufficiency of Japan's agricultural sectors or the proportion of domestic production in total output increased consistently from 1960 to 1985, unlike Taiwan and Korea which posted decreases in their rates of self-sufficiency for the same period. This implies that a decrease in the rate of self-sufficiency increases the number of production rounds required to satisfy final demand requirements. The number of production rounds increases because the country would have to import the gap between domestic production and domestic consumption. In the input-output framework, importation imposes additional interindustry transactions cost because imports represent leakages out of the economy. These additional interindustry transactions cost are manifested in an increase in the number of production rounds required by the sector to adjust to exogenous changes in final demand.

Since in the interindustry framework the rate of self-sufficiency of those sectors that provide inputs to agriculture indirectly affects the production response of agriculture to changes in final demand, one can surmise that the decrease in the number of production rounds required by the agricultural sector in Japan to satisfy a substantial portion of final demand is also due to the improvement of the rates of self-sufficiency of sectors providing vital inputs to agricultural production. This perspective helps explain why the Philippines showed an increase in the number of production rounds through time despite its comparative advantage in agricultural production. Although the Philippines is naturally endowed with resources for agricultural production, the rates of self-sufficiency of the sectors producing agricultural inputs decreased or remained stagnant through time.[10]

3.2 Production Generation Mechanism

Equation 2 was used to analyze the production generation mechanism of agriculture through time. To avoid double counting of the influence of the rate of self-sufficiency on the realization of multiplier effects, the global Leontief inverse matrix, $(I-A)^{-1}$ was used. An important procedure in the empirical application of the sequential input-output model (Equation 2) is the determination of the production lag. The Robinson-Markandya Quantity Adjustment Model (Equation 4) was used to determine the production lag of agriculture. Thus, the figures presented in Table 4 also represent the production lags for agricultural crops and livestock.

The initial impact was a ten million change in final demand for agriculture. The output multiplier effect of the initial impact was computed for six periods. The sum of the effects after six production lags were then analyzed. The sum was compared with the total multiplier effect and the total sectoral multiplier effect. The sum of the column elements of the Leontief inverse matrix is referred to as the total multiplier effect and the individual column elements represent the total sectoral multiplier effect. Analysis was made for one and two impacted sectors. The results for the one impacted sector case is shown in Table 6, while that of the two impacted sector case is shown in Table 7.

As shown in Tables 6 and 7, a major portion of the total multiplier effects of an exogenous change in one or both agricultural sectors are realized more at relatively lower levels of agricultural

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[10] For indications of the sad state of Philippine industrial development from the 1950's to the 1980's, see Harry T. Oshima, Economic Growth in Monsoon Asia (Tokyo: University of Tokyo Press, 1987), 216-223.
For a discussion of the relationship between industrialization and agricultural productivity growth as applied to the Asian path of agricultural development, see Yujiro Hayami and Vernon Ruttan, Agricultural Development: An International Perspective, Rev. and exp. ed.(Baltimore: The Johns Hopkins University Press, 1985), 129-137.

transformation. As mentioned in Section 2, Japan has a relatively higher level of agricultural transformation, followed by Taiwan, Korea, and the Philippines. The Philippines, however, registered the highest average percentage of realized total multiplier effects, followed by Korea, Taiwan, and Japan. Thus, the relative degree of agricultural transformation exhibits an inverse relationship with the percentage of realized total multiplier effects of an exogenous change in the agricultural sectors.

The inverse relationship observed between the relative level of agricultural transformation through time and the realization of total multiplier effects can be traced directly to the nature of agricultural interindustry transactions in a given economy. At higher levels of agricultural transformation, agricultural interindustry transactions are expected to be relatively more complex or varied. As the interindustry transactions become more complex, production generation in response to exogenous changes spans a longer period because of the need to conduct multiple interindustry transactions. The percentage of realized total multiplier effects therefore becomes smaller as interindustry transactions become more complex.

A significant portion of the sectoral multiplier effects of an exogenous change in agriculture also tends to be realized in more sectors at relatively lower levels of agricultural transformation. As shown in Tables 6 and 7, the number of sectors in which sixty percent of the sectoral multiplier effects had been realized after six production lag periods is greater in the Philippines than in Japan, Taiwan, and Korea. This result is similar to the result obtained for the total multiplier effects.

4. Summary and Conclusions

Using input-output analysis, this study has shown that there are distinct patterns of development in the production generation and adjustment mechanisms of agriculture through time in Japan, Korea, Taiwan, and the Philippines. The Robinson-Markandya model was used to establish that the number of production rounds taken by agriculture to adjust production due to exogenous changes in final demand increases through time. The number of production rounds continues to increase until a relatively high level of agricultural transformation is reached. At this point, the number of production rounds required by agriculture to produce output necessary to satisfy exogenous changes in final demand decreases due to improvements in the rate of self-sufficiency of agriculture and the sectors that provide inputs to agriculture.

This pattern of development in structural input-output relationships implies that the production generation mechanism and interindustry transactions efficiency of agriculture is improved by enhancing the potential of the country to produce strategic agricultural inputs or by allowing those in the agricultural sector to have access to those agricultural inputs that the country cannot produce efficiently in the most efficient way, that is , through liberalized trade. Thus, it can be inferred that since importing agricultural inputs in itself imposes additional interindustry transactions cost, restrictions imposed on the importation of these inputs cause further strain on the interindustry transactions efficiency of agriculture.

Sequential input-output analysis was used to show that the realized total and sectoral multiplier effects of an exogenous change in agriculture decreases with the attainment of higher levels of agricultural transformation. This pattern of development in the production generation mechanism of agriculture suggests that the impact effect of any exogenous change in agriculture on the whole economy can be realized more easily at a relatively lower level of agricultural transformation since at that level of transformation agriculture has few and simple interindustry transactions. An inverse relationship therefore exists between realized multiplier effects and transactions complexity. This inverse relationship hints at the importance of sufficiently developing and stimulating agriculture when its interindustry relationships are not yet complex because this is a level of transformation when the realized multiplier effects of exogenous changes are high.[11]

[11] This assumes that the dispersion or the quality of realized multiplier effects is not given top priority.

The above observations confirm the hypothesis that there is a uniform tendency in the way demand, trade, and technological interdependence affect the way agricultural interdependent production relationships change and develop in the process of agricultural transformation within the Asian path. The Asian path therefore has distinct interindustry aspects as reflected in the patterns of change in the production generation and adjustment mechanisms of agriculture in Japan, Taiwan, Korea, and the Philippines.

References

Bulmer-Thomas, Victor, 1982. Input-Output Analysis in Developing Countries. John Wiley and Sons, Ltd., New York, NY.

Ghatak, Subrata and Ingersent, Ken, 1984. Agriculture and Economic Development. Wheatleaf Books, Ltd., Sussex.

Hayami, Yujiro and Ruttan, Vernon, 1985. Agricultural Development: An International Perspective. Rev. and exp. ed. Johns Hopkins University Press, Baltimore, MD.

Miller, Ronald and Blair, Peter, 1985. Input-Output Analysis: Foundations and Extensions. Prentice-Hall, Inc., Englewood Cliffs, NJ.

Mules, Trevor J., 1983. Some simulations with a sequential input-output model. Papers of the Regional Science Asso.,59: 73-91.

Oshima, Harry T., 1987. Economic Growth in Monsoon Asia. University of Tokyo Press, Tokyo, Japan.

Robinson, Sherman and Markandya, Anil, 1973. Complexity and adjustment in input-output systems. Oxford Bulletin of Econ. and Stat. 35: 119-134.

Timmer, Peter, 1988. The Agricultural Transformation. In: Handbook of Development Economics, edited by H.B. Chenery and T.N. Srinivasan. North Holland Publishing Co., Amsterdam, Holland.

Table 1
Input-output tables and sources

Country	I-O Year	No. of Sectors	Source
JAPAN	1960	56 and 63	Management and Coordination Agency (Ministry of International Trade & Industry)
	1965	56 and 163	(same as above)
	1970	28 and 71	(same as above)
	1975	28 and 71	(same as above)
	1980	28 and 71	(same as above)
	1985	28 and 84	(same as above)
TAIWAN	1964	49 and 76	Council for Economic Planning & Development, Executive Yuan
	1969	49 and 76	(same as above)
	1971	49 and 76	(same as above)
	1976	29 and 394	(same as above)
	1981	49 and 99	(same as above)
	1986	49 and 99	(same as above)
KOREA	1963	43 and 109	The Bank of Korea
	1968	43 and 109	(same as above)
	1970	56 and 153	(same as above
	1975	60 and 164	(same as above)
	1980	65 and 161	(same as above)
	1985	65 and 161	(same as above)
PHILIPPINES	1961	50 and 99	National Economic Council
	1965	51 and 99	Bureau of Census and Statistics
	1969	60 and 99	National Economic Development Authority/National Census and Statistics Office
	1974	60 and 99	(same as above)
	1979	24 and 65	(same as above)
	1983	25 and 65	(same as above)

Table 2
Sectoral classification

SECTOR	SYMBOL
Agricultural Crops [a]	AGC
Livestock [b]	LS
Agricultural Services [c]	AGS
Forestry	FOR
Fishery	FISH
Mining	MNG
Food Manufacturing	FMFG
Manufacturing	MFG
Chemicals	CHEM
Machinery	MACH
Construction	CONST
Electricity, Gas, Water/ Transportation and Communication	PUTC
Wholesale and Retail Trade	COM
Finance, Insurance, Real Estate	FIRE
Public Administration/Services	PWS
Others	OTH

[a] Includes Grains (rice, wheat, barley, cereals, corn), Fruits and Vegetables, and Industrial Crops.
[b] Includes Hogs, Cattle, Other Livestock, and Livestock Products.
[c] Includes Veterinary and Other Agricultural Services.

Table 3

Change in the share of agriculture in the industrial employment structure

COUNTRY	YEAR	SHARE
JAPAN [a]	1960	30.3 %
	1965	22.8 %
	1970	17.9 %
	1975	12.6 %
	1980	9.9 %
	1985	8.3 %
TAIWAN [b]	1964	40.5 %
	1969	34.7 %
	1971	31.5 %
	1976	24.8 %
	1981	16.6 %
	1986	15.0 %
KOREA [c]	1963	56.2 %
	1968	62.6 %
	1970	47.9 %
	1975	46.2 %
	1980	35.1 %
	1985	23.2 %
PHILIPPINES [d]	1961	55.8 %
	1965	52.1 %
	1969	52.7 %
	1974	44.2 %
	1979	38.8 %
	1983	39.0 %

[a] Source of Data is Census of Population.

[b] Sources of Data are the following: Demographic Factbook, Republic of China, Department of Civil Affairs; Statistical Abstract of the Republic of China, Directorate-General of Budgets, Accounts, and Statistics (Executive Yuan); and Yearbook of Labor Statistics, International Labor Organization.

[c] Sources of Data are the following: Population and Housing Census Report, National Bureau of Statistics, Economic Planning Board; Korea Statistical Yearbook, Economic Planning Board; and Yearbook of Labor Statistics, International Labor Organization.

[d] Sources of Data are the following: National Economic Development Authority Statistical Yearbook, National Statistical Coordination Board; and Census of Population and Housing, National Census and Statistics Office.

Table 4
Change in the number of interindustry production rounds for the agricultural sectors [a]

COUNTRY	YEAR	AGC	LS
JAPAN	1960	6	10
	1965	5	6
	1970	5	5
	1975	5	6
	1980	5	5
	1985	5	5
TAIWAN	1964	4	3
	1969	4	5
	1971	4	4
	1976	5	5
	1981	5	5
	1986	5	5
KOREA	1963	3	4
	1968	3	4
	1970	3	4
	1975	4	5
	1980	5	5
	1985	5	5
PHILIPPINES	1961	3	2
	1965	3	2
	1969	3	3
	1974	3	3
	1979	4	4
	1983	4	4

[a] The number of production rounds was computed using the Robinson-Markandya Quantity Adjustment Model. The model is presented as Equation 4. Agricultural sectors refer to agricultural crops (AGC) and livestock (LS).

Table 5
Change in the import rate[a] and rate of self-sufficiency[b] of agricultural sectors[c]

COUNTRY	YEAR	IMPORT RATE	SELF-SUFFICIENCY
JAPAN	1960	19.7 %	80.3 %
	1965	18.9 %	81.1 %
	1970	18.3 %	81.7 %
	1975	18.0 %	82.0 %
	1980	17.9 %	82.1 %
	1985	15.5 %	84.5 %
TAIWAN	1964	9.9 %	90.1 %
	1969	14.9 %	85.1 %
	1971	18.0 %	82.0 %
	1976	21.5 %	78.5 %
	1981	34.6 %	65.4 %
	1986	19.8 %	81.2 %
KOREA	1963	8.0 %	92.0 %
	1968	6.0 %	94.0 %
	1970	11.7 %	88.3 %
	1975	13.0 %	87.0 %
	1980	15.3 %	84.7 %
	1985	13.0 %	87.0 %
PHILIPPINES	1961	4.7 %	95.3 %
	1965	3.4 %	96.6 %
	1969	2.8 %	97.2 %
	1974	5.3 %	94.7 %
	1979	3.3 %	96.7 %
	1983	1.2 %	98.8 %

[a] Import rates were computed using the corresponding input-output tables. The import rate is simply the ratio of total imports to total intermediate and domestic final demand.
[b] The rate of self-sufficiency is simply the difference between 1 and the import rate.
[c] Agricultural sectors refer to agricultural crops (AGC) and livestock (LS).

Table 6
Cumulative multiplier effects of a change in final demand for agriculture: one impacted sector (after six production rounds[a]

COUNTRY	YEAR	AGC[b]	*[c]	LS	*[d]
JAPAN	1960	81.5 %	4	77.6 %	5
	1965	85.2 %	7	76.4 %	6
	1970	94.8 %	6	73.4 %	3
	1975	84.0 %	6	75.5 %	6
	1980	78.9 %	4	70.2 %	4
	1985	82.9 %	7	71.1 %	3
TAIWAN	1964	92.3 %	10	87.5 %	5
	1969	87.1 %	10	75.7 %	5
	1971	88.2 %	9	76.8 %	6
	1976	88.5 %	4	69.2 %	4
	1981	87.1 %	4	66.9 %	3
	1986	88.9 %	5	68.5 %	2
KOREA	1963	94.2 %	12	87.7 %	10
	1968	91.8 %	9	89.1 %	8
	1970	93.4 %	10	87.1 %	9
	1975	91.7 %	6	82.0 %	9
	1980	88.8 %	6	75.9 %	8
	1985	90.0 %	6	78.5 %	4
PHILIPPINES	1961	99.0 %	13	98.0 %	13
	1965	99.4 %	12	98.1 %	15
	1969	99.0 %	13	97.5 %	13
	1974	99.0 %	10	97.3 %	12
	1979	97.1 %	11	84.3 %	8
	1983	95.6 %	8	84.7 %	6

[a] Computed using the sequential input-output model. The model is presented as Equation 2. Production lags were determined using Equation 4.
[b] Columns for AGC (agricultural crops) and LS (livestock) show the realized multiplier effects as a percentage of the total multiplier effect.
[c] Number of sectors in which sixty percent of the sectoral multiplier effects of agricultural crops had been realized after six production lag periods.
[d] Number of sectors in which sixty percent of the sectoral multiplier effects of livestock had been realized after six production lag periods.

Table 7
Cumulative multiplier effects of a change in final demand for agriculture: two impacted sectors (after six production lag periods)[a]

COUNTRY	YEAR	AGC/LS[b]	*[c]
JAPAN	1960	79.3 %	6
	1965	79.8 %	7
	1970	77.9 %	5
	1975	78.8 %	7
	1980	73.7 %	5
	1985	75.7 %	4
TAIWAN	1964	89.4 %	7
	1969	80.1 %	8
	1971	81.2 %	8
	1976	76.0 %	6
	1981	74.1 %	5
	1986	75.7 %	5
KOREA	1963	90.5 %	10
	1968	90.4 %	9
	1970	89.6 %	9
	1975	85.8 %	9
	1980	80.9 %	8
	1985	78.7 %	8
PHILIPPINES	1961	98.5 %	14
	1965	98.7 %	15
	1969	98.2 %	13
	1974	98.0 %	12
	1979	89.5 %	11
	1983	87.8 %	10

[a] Computed using the sequential input-output model. The model is presented as Equation 2. Production lags were determined using Equation 4.
[b] Column shows the realized multiplier effect of an exogenous change in final demand for both agricultural crops (AGC) and livestock (LS) as a percentage of the total multiplier effect.
[c] Number of sectors in which sixty percent of the sectoral multiplier effects of an exogenous change in final demand for both agricultural crops (AGC) and livestock (LS) had been realized after six production lag periods.