

FACTORS AFFECTING PORK PRICE IN TAIWAN

by

MING HONG CHOW

B. S., College of Chinese Culture, 1975

Taipei, Taiwan

A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Agricultural Economics

KANSAS STATE UNIVERSITY

Manhattan, Kansas

1979

Approved by:



Major Professor

Document
hD
2668
.R4
1979
C52
C. 2

ACKNOWLEDGEMENTS

I wish to express my sincere appreciation to Dr. Orlo Sorenson, for his constant advise and assistance during the writing of this study. I also wish to express my gratitude to the members of my graduate committee, Dr. John McCoy and Dr. Richard Phillips, for their helps and guidances in the completion of my work.

Especial thanks go to my parents, Mr. and Mrs. Honwan Chow, for their encouragements and supports during my graduate study. Special acknowledgment is expressed to my wife, Pei-Pei, who typed, listened, consoled, and encouraged throughout my graduate study.

**THIS BOOK
CONTAINS
NUMEROUS PAGES
WITH THE ORIGINAL
PRINTING BEING
SKEWED
DIFFERENTLY FROM
THE TOP OF THE
PAGE TO THE
BOTTOM.**

**THIS IS AS RECEIVED
FROM THE
CUSTOMER.**

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	ii
LIST OF TABLES.....	v
LIST OF FIGURES	vii
Chapter	
I. INTRODUCTION.....	1
A. Purpose and Procedures.....	1
II. THE PORK INDUSTRY IN TAIWAN.....	5
A. Economic Position of Pork Based on Aggregate Production....	5
B. Hog Raising and the Farm Family.....	5
C. Trend in Consumption of all Meat.....	8
D. Tax Revenues Gained from Pork.....	8
III. SUPPLY AND DEMAND PATTERN.....	12
A. Supply.....	12
1. location.....	12
2. structure.....	15
3. production cost.....	20
B. Demand.....	23
1. growth in income.....	24
2. supply of competing meats.....	26
3. pork exports.....	26
IV. FACTORS AFFECTING PORK PRICES.....	30
A. Personal Disposable Income.....	30
B. Consumption of Fish and Poultry.....	30
C. Consumption of Pork.....	33
D. Prices of Poultry and Fish.....	34
E. Pigs Born in Last Year.....	34
F. Exports and other Factors.....	35
V. STATISTICAL MODEL.....	37
A. Correlation Coefficients between Retail Price of Pork and Factors Affecting Price.....	37
1. real per capita personal disposable income.....	37
2. pigs born last year.....	37
3. weighted average retail price of poultry and fish.....	39
4. per capita pork consumption.....	39
5. combined per capita poultry and fish consumption.....	39
6. relation between pork consumption and combined consumption of poultry and fish.....	41

TABLE OF CONTENTS (Continued)

	Page
Chapter	
B. Building a Multiple Regression Model for Historical Trend..	41
a. forward selection procedure.....	42
b. backward elimination procedure.....	42
c. stepwise regression procedure.....	44
d. all possible regression procedure.....	44
C. Pork Price Projection.....	45
VI. SUMMARY AND CONCLUSION.....	49
BIBLIOGRAPHY.....	51

LIST OF TABLE

	Page
Table	
1. Percentage of total meat consumption by type of meat (not including fish) in Taiwan from 1956-1974.....	4
2. Percentage distribution of total value of crops and livestock in Taiwan in NT\$ at current value, 1952-1976.....	6
3. Number of farm families and hog-feeding families, Taiwan, 1952-1976.....	7
4. Farm and off-farm income of farm families, Taiwan, 1958-1975....	9
5. Per capita consumptions of meat and fish, Taiwan, 1956-1974.....	10
6. Total tax revenue and slaughter tax revenue of city and hsin in Taiwan, annually 1961-1973.....	11
7. Hog supply by areas, Taiwan, 1951-1976.....	13
8. Average slaughtered weight and ratio of hogs slaughtered to pigs born annually in Taiwan, 1952-1976.....	16
9. Import of corn and soybean, Taiwan, 1952-1974, at current prices.....	18
10. Number, index and percentage of hogs produced in Taiwan 1972, 1973 and 1974 by size of production unit.....	19
11. Size distribution of hog-raising production unit in Taiwan, 1974.....	21
12. Index of seasonal variation (percent of annual averages) in number of hogs slaughtered and in retail prices of pork, Taiwan, 1950 to 1974.....	25
13. Agricultural production---index number (1952 = 100), 1952-1974.....	27
14. Exports of live hogs and pork from Taiwan, Annually, 1955 through 1974.....	29
15. Real value of national income, per capita income, and per capita personal disposable income.(adjusted at 1971price)...	32

LIST OF TABLE (Continued)

Table	Page
16. Data for pork price model, Taiwan, 1956-1974.....	38
17. Data for pork price model, Taiwan, 1956-1974.....	40
18. Correlation coefficient matrix table.....	43
19. Residual mean square of all posible regression models.....	46
20. Projected value of those affecting factors and pork retail price, 1979-1985.....	48

LIST OF FIGURES

Figure	Page
1. Percentage of Taiwan farm families raising hogs by year, 1952-1976.....	3
2. The map of Taiwan.....	14
3. Taiwan hog producer and number of hogs raised by annual production, July 1974.....	22
4. Structure of the pork industry in Taiwan.....	31

FACTORS AFFECTING PORK PRICE IN TAIWAN

I. Introduction

It is apparent that hog raising is very closely interwoven with Chinese family living. In Chinese characters comparing hog and home, it will be noted that "home" is a roof that covers over "hog"*. Data in Figure 1 show that historically hogs are raised on almost every farm, indicating the importance of hog raising in Chinese culture. Table 1 shows that pork is the most important meat consumed in Taiwan. Pork consumption has been maintained at a high percentage of total red meat and poultry consumption, registering from 88.93 percent of total consumption of meat in 1958 to 72.35 percent in 1971. It is recognized that pork is an important and influential meat to the Chinese and hence a potential industry to develop.

A. Purpose and Procedures

The main purposes of the report are to review changes occurring in both supply and demand conditions for pork in Taiwan; to identify major factors influencing retail price behavior for pork; and to project pork prices in the future by using historical trends. Information for this report was obtained from public reports of official government departments of the Republic of China and from recent economic studies of the pork industry.

Procedures followed in this study are expressed in steps below. First, historical supply and demand data are reviewed and the supply and demand condition for pork in Taiwan are assessed. Second, those factors affecting supply and demand are pointed out and discussed. Third, long-term trends are calcu-

* Home- 家

Hog- 豕

lated and a regression model fitted to retail price data through the use of multiple regression. Finally, the regression model is used to predict pork retail price for a future period.

FIGURE 1

PERCENTAGE OF TAIWAN FARM FAMILIES
RAISING HOGS BY YEAR, 1952-1976
DATA COME FROM TABLE 3

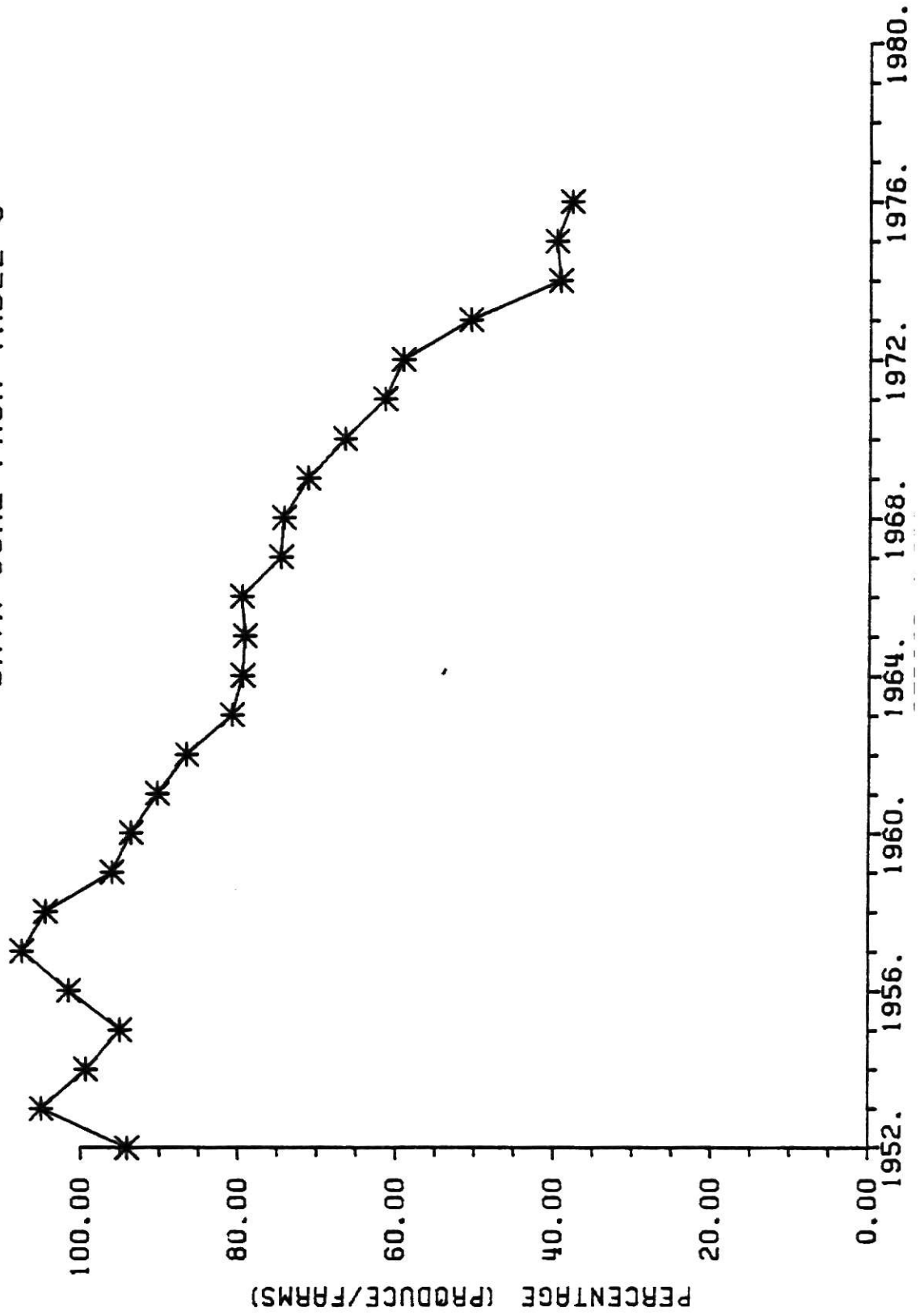


Table 1

Percentage of total meat consumption by type of meat(not including fish)
in Taiwan from 1956-1974.

MEAT					
Perid	Pork	Poultry	Beef	Lamb	Total
1956	86.69	10.77	2.23	0.31	100.00
1957	88.19	9.57	1.96	0.28	100.00
1958	88.93	9.09	1.601	0.38	100.00
1959	87.87	9.93	1.79	0.41	100.00
1960	87.03	10.43	2.16	0.37	100.00
1961	87.95	9.59	2.12	0.34	100.00
1962	85.24	11.05	3.33	0.38	100.00
1963	83.88	11.25	4.54	0.33	100.00
1964	84.06	11.21	4.35	0.38	100.00
1965	84.91	12.31	2.41	0.37	100.00
1966	76.55	21.01	2.09	0.35	100.00
1967	74.69	22.78	2.22	0.31	100.00
1968	72.69	24.23	2.78	0.30	100.00
1969	73.66	23.34	2.66	0.34	100.00
1970	75.16	22.01	2.52	0.31	100.00
1971	72.35	25.31	2.00	0.34	100.00
1972	72.37	26.01	1.33	0.29	100.00
1973	75.48	22.68	1.53	0.31	100.00
1974	73.79	24.55	1.57	0.29	100.00

Source: "Economic Analysis of Hog Industry in Taiwan" C. Y. Lee
1976, Department of Agricultural Economics, National
Chung Hsin University, P.8

II. The Pork Industry in Taiwan

A. Economic position of pork based on aggregate production

Increases of prices and production of pork since the 1950's have resulted in a rapid increase in the total value of Taiwan pork production. Total value of pork production of NT\$670 million in 1952 (which is 9.25 percent of the total value of all crops, livestock and forestry and fishery products) went up to NT\$22 billion in 1976. In 1976, pork represented 16.48 percent of the total value of crops, livestock, poultry and fishery production. Total value of pork relative to the total value of crops and livestock alone increased from 11.53 percent in 1952 to 20.45 percent in 1976. The value of common crops decreased from 61.60 percent of total value of crops and livestock in 1952 to 38.04 percent in 1976 (see Table 2). These data show that pork occupies an important position in the economic value of aggregate agricultural production.

B. Hog raising and the farm family

Hog raising, formerly a farm family sideline enterprise, has in recent years received government support and encouragement to expand as a commercial enterprise*. Historically, almost every farm family raised a few head of hogs but in recent years a sharp change in production patterns has occurred (see Table 3). In 1952 there were 693,082 farm families raising hogs, which was 94.01 percent of all farm families. In 1957 the number of families raising hogs went up to 816,421. This number exceeded the reported number of contemporary farm families**. A gradual decrease was noted after 1957. However, by 1976 sideline production had decreased more sharply. In 1976, 37.85 percent

* "Taiwan Agricultural Yearbook" 1977 Edition, Department of Agriculture and Forestry, Republic of China. P. 248

** This indicates that a small number of non-farm families also raised hogs.

Table 2

Percentage distribution of total value of crops and livestock in Taiwan in NT\$
at current value, 1952-1976. (unit=percent).

Agriculture and Livestock Production

Period	Total	Common crop	Special crop	Horticultural crop	Sericulture	Livestock produce	Value of pork produce	Total value of agriculture & livestock produce
1952	100	61.60	16.85	7.13	0.01	14.41		11.53
1953	100	61.97	18.87	5.21	0.01	13.94		11.33
1954	100	59.12	15.74	6.87	0.02	18.25		14.70
1955	100	57.54	17.10	6.64	0.02	18.70		15.65
1956	100	57.85	16.86	6.57	0.04	18.68		15.51
1957	100	52.72	16.66	6.45	0.02	24.15		15.67
1958	100	51.48	16.07	8.09	0.02	24.34		15.72
1959	100	48.02	16.85	8.10	0.02	27.01		17.79
1960	100	54.87	13.10	7.45	0.02	24.56		16.24
1961	100	53.74	14.21	7.12	0.02	24.91		17.00
1962	100	51.61	13.40	8.10	0.02	26.87		18.17
1963	100	48.55	14.28	10.34	0.02	26.81		17.76
1964	100	46.95	18.23	10.64	0.02	24.16		18.14
1965	100	46.97	13.71	14.64	0.01	24.67		16.06
1966	100	47.47	11.98	15.33	0.02	25.21		16.42
1967	100	47.15	11.01	15.92	0.02	25.90		17.01
1968	100	44.72	10.47	17.17	0.02	27.63		18.04
1969	100	42.59	10.70	17.99	0.02	28.70		18.45
1970	100	40.71	10.05	19.56	0.02	29.65		19.77
1971	100	37.90	10.15	19.78	0.02	32.15		21.41
1972	100	37.57	9.61	19.19	0.02	33.61		21.27
1973	100	37.90	9.03	18.28	0.01	34.78		21.24
1974	100	40.95	10.97	15.95	0.03	32.10		19.77
1975	100	40.14	13.98	15.74	0.05	30.09		17.84
1976	100	38.04	10.22	17.50	0.06	34.18		20.45

Source: "Taiwan Agricultural Yearbook" 1977, Department of Agriculture and Forestry, Provincial Government of Taiwan.

Table 3

Number of farm families and hog-feeding families, Taiwan, 1952-1976.

Period	Farm family(1)	Hog-feeding family(2)	$((2)/(1)) \times 100\%$
1952	679,750	639,082	94.01
1953	702,325	736,874	104.92
1954	712,582	711,385	99.27
1955	732,555	695,020	94.88
1956	746,318	756,988	101.43
1957	759,234	816,421	107.38
1958	769,925	803,670	104.38
1959	780,402	748,804	95.95
1960	785,592	734,991	93.56
1961	800,835	722,883	90.27
1962	809,917	701,050	86.56
1963	824,560	665,915	80.76
1964	834,827	662,827	79.40
1965	847,247	670,402	79.55
1966	854,203	679,553	79.55
1967	868,731	663,820	76.41
1968	877,114	651,342	74.26
1969	887,112	631,686	71.21
1970	880,274	585,652	66.53
1971	879,005	540,583	61.50
1972	879,526	520,670	59.20
1973	876,565	444,020	50.65
1974	877,829	344,832	39.28
1975	867,547	345,199	39.79
1976	870,787	329,607	37.85

Source: "Taiwan Agricultural Yearbook" 1977, Department of Agricultural and Forestry, Provincial Government of Taiwan.

of Taiwan farm families were raising hogs. Number of farmers raising hogs decreased rapidly in 1972 and 1973. Despite a reduced number of producers, hogs still are produced by a high percentage of farm families.

Hog sales continue to contribute much to the total income of the farmers. The share of total sales revenue from hogs increased from 17.27 percent in 1958 to 27.98 percent in 1975. However, revenue from sale of crops decreased from 78.27 percent to 68.86 percent in the same period (see Table 4). Although number of farms raising hogs decreased, revenue from raising hog still plays an important role in farm income.

C. Trend in consumption of all meat

People who live in Taiwan consume animal protein, usually, from fish, pork, beef, lamb, and poultry. Pork and fish are the main sources of animal protein (see Table 5). Taiwan, which is surrounded by ocean, produces lots of fish and its consumption increases each year. Consumption of fish, beef and poultry also has increased in recent years, but a large increase in pork consumption also has been registered.

D. Tax revenues gained from pork

Tax related to pork have contributed a large amount of government income in Taiwan. In some areas, slaughter tax is the main income for government administration expenses (see Table 6). Also revenue from exports of pork increase the national wealth. Increase of pork export and hence expansion of foreign exchange earnings could motivate further promotion of pork production.

Table 4

Farm and off-farm income of farm families, Taiwan, 1958-1975 (unit=NT\$).

Period	Total revenue	Farm Income				Off-farm			
		sub-total		cultivative revenue		livestock revenue		other revenue	
		amount	% (1)	amount	% (2)	amount	% (2)	amount	% (1)
1958	38,014	32,791	86.26	25,667	78.27	5,696	17.37	1,428	4.35
1959	43,802	36,949	84.35	27,514	74.46	5,930	21.46	1,505	4.07
1960	56,932	52,372	91.99	43,136	82.36	9,345	17.84	891	1.70
1961	63,595	58,307	91.68	45,215	77.55	10,337	17.73	2,755	4.72
1962	62,129	55,971	90.09	43,968	78.55	9,211	16.46	2,792	4.99
1963	68,281	62,290	91.23	48,553	77.95	11,045	17.73	2,692	4.32
1964	63,802	55,937	87.67	43,286	77.38	10,732	19.19	1,919	3.43
1965	68,773	59,934	87.15	46,335	77.31	11,790	19.67	1,809	3.02
1966	79,313	69,931	88.17	51,761	74.02	14,406	20.60	3,764	5.38
1967	84,143	73,665	87.55	55,743	75.67	14,725	19.99	3,197	4.34
1968	94,077	81,651	86.79	59,811	73.25	18,540	22.71	3,300	4.04
1969	84,113	68,311	81.21	48,745	71.36	15,941	23.34	3,625	5.31
1970	88,391	73,291	82.92	54,865	74.86	15,701	21.42	2,725	3.72
1971	100,316	83,494	82.41	56,869	68.11	23,491	28.13	3,134	3.75
1972	124,447	92,871	74.63	63,319	68.18	26,134	28.14	3,418	3.68
1973	148,589	106,966	71.99	73,673	68.88	28,276	26.43	5,018	4.69
1974	207,432	154,146	74.31	109,349	70.94	39,669	25.73	2,097	1.36
1975	242,376	172,737	71.27	118,947	68.86	48,332	27.98	5,458	3.16

Source: "Report of Farm Booking", 1975, Department of Agriculture and Forestry, Provincial Government of Taiwan.

(1): Percent of total revenue.

(2): Percent of Sub-total revenue.

Table 5
Per capita consumptions of meat and fish, Taiwan, 1956-1974.

Period	Meat								total		Fish
	pork		poultry		beef		lamb				
	Kg	%	Kg	%	Kg	%	Kg	%	Kg	%	
1956	11.27	86.69	1.40	10.77	0.29	2.23	0.04	0.31	13.00	100.00	18.81
1957	12.62	88.19	1.37	9.57	0.28	1.96	0.04	0.28	14.31	100.00	19.49
1958	13.90	88.93	1.42	9.09	0.25	1.60	0.06	0.38	15.63	100.00	20.74
1959	12.75	87.87	1.44	9.92	0.26	1.79	0.06	0.41	14.51	100.00	21.29
1960	11.68	87.03	1.40	10.43	0.29	2.16	0.05	0.37	13.42	100.00	21.67
1961	12.84	87.95	1.40	9.59	0.31	2.12	0.05	0.34	14.60	100.00	25.33
1962	13.34	85.24	1.73	11.05	0.52	3.32	0.06	0.38	15.65	100.00	26.14
1963	12.75	83.88	1.71	11.25	0.69	4.54	0.05	0.33	15.20	100.00	27.27
1964	13.13	84.06	1.75	11.20	0.68	4.35	0.06	0.38	15.62	100.00	28.20
1965	13.73	84.91	1.99	12.31	0.39	2.41	0.06	0.37	16.17	100.00	27.74
1966	15.05	76.55	4.13	21.01	0.41	2.09	0.07	0.36	19.66	100.00	28.84
1967	16.79	74.69	5.12	22.78	0.50	2.22	0.07	0.31	22.48	100.00	28.69
1968	16.98	72.69	5.66	24.23	0.65	2.78	0.07	0.30	23.36	100.00	29.69
1969	17.42	73.66	5.52	23.34	0.63	2.66	0.08	0.34	23.65	100.00	30.32
1970	19.12	75.16	5.60	22.01	0.64	2.52	0.08	0.31	25.44	100.00	34.18
1971	19.15	72.35	6.70	25.31	0.53	2.00	0.09	0.34	26.47	100.00	34.34
1972	20.09	72.37	7.22	26.01	0.37	1.33	0.08	0.29	27.76	100.00	35.28
1973	21.67	75.48	6.51	22.68	0.44	1.53	0.09	0.31	28.71	100.00	36.96
1974	20.50	73.79	6.82	24.55	0.38	1.37	0.08	0.29	27.78	100.00	34.25

Sources: (1) "Economic Analysis of Hog Industry in Taiwan" C.Y. Lee, 1976, Department of Agricultural Economics, National Chung Hsin University, P.8

(2) "Food Balance Sheet" 1975, Joint Commission on Rural Reconstruction.

(3) "Production and Operation of Foodstuff Produce in Taiwan", 1975, Taiwan Provincial Food Bureau.

Table 6

Total Tax Revenue and Slaughter Tax Revenue of City and Hsien in Taiwan,
Annually 1961-1973, (unit:NT\$1,000).

Period	Tax revenue(1)	Slaughter tax revenue(2)	(2)/(1)
1961	1,107,573	338,409	30.55
1962	1,261,297	387,531	30.72
1963	1,393,147	471,968	33.88
1964	1,582,929	484,888	30.63
1965	1,871,629	555,228	29.67
1966	2,254,701	641,775	28.46
1967	2,505,417	728,781	29.09
1968	2,197,754	664,837	30.25
1969	2,697,654	613,465	22.74
1970	3,663,910	712,638	19.45
1971	4,067,917	791,230	19.45
1972	4,478,123	780,915	17.44
1973	5,438,341	875,321	16.10

Sources: (1) "Taiwan Statistical Data Book" 1975, Economic Planning Council,
Executive Yuan, Republic of China.

(2) "Production and Operation of Foodstuff Produce in Taiwan" 1975,
Taiwan Provincial Food Bureau.

III. Supply and Demand Pattern

Domestic supply and demand factors for pork in Taiwan will be identified in this section. Dramatic changes in production techniques, and hence supply have occurred over the past two decades. Economic growth and increases in income levels have also sharply changed demand patterns for pork in Taiwan.

A. Supply

First, the characteristics of supply and changing condition relating to hog production in Taiwan will be discussed.

1. Location:

The location of hog feeding is influenced by the location of feed production. Historically, sweet potato and its stock has been the main feed for hogs in Taiwan. There was a positive correlation between location of hog production and location of sweet potato production. As the production of sweet potato was concentrated in the southern part of the island, more hogs were fed in the south than in the north*. In recent years, even though producers have changed rations with less dependence on sweet potatoes, the main supply area is still the southern portion of Taiwan. New producers using imported feeds have located their plants in the southern part of Taiwan. Government efforts to encourage increased domestic production of feedstuffs have been concentrated in the southern area. The number of hog feeders in the south has increased in recent years. On the other hand, other areas have registered a decline in number of hog feeders (see Table 7). A tendency for hog production to concentrate in the south has continued for more than two decades.

*"Production and Supply of Hog in Taiwan" Kou, Y. C. March, 1976. National Chung Hsin University, Department of Agricultural Economics, P.P. 41-47.

Table 7

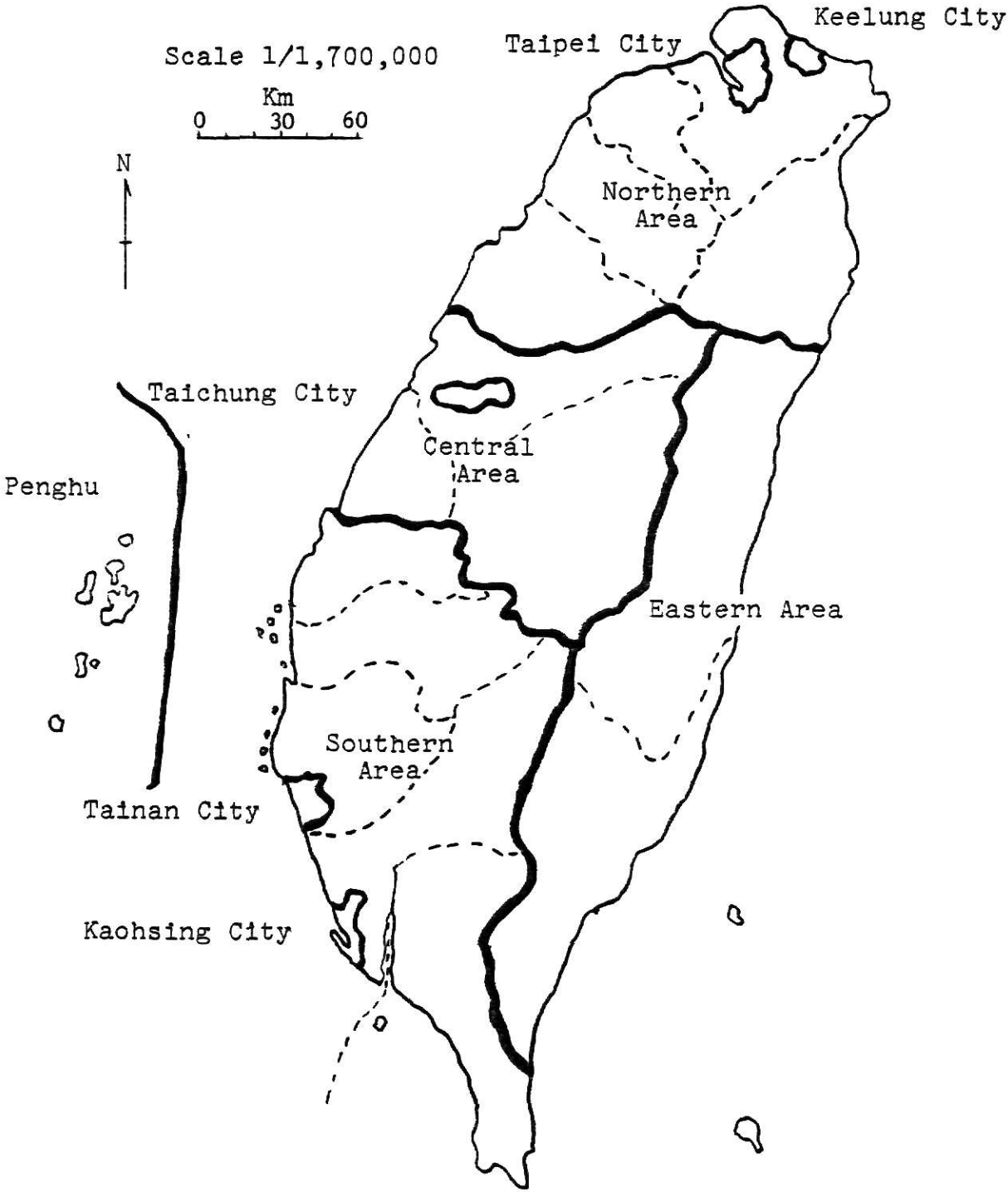
Hog Supply by Areas, Taiwan, 1951-1976.

	year	area	urban	northern	central	eastern	penghu	southern	total
			area	area	area	area	area	area	
number of hogs	1951		157,524	737,564	560,119	137,380	19,133	1,944,962	3,556,682
	1962		230,224	1,146,838	898,171	237,402	36,740	2,792,688	5,342,063
	1970		261,018	1,382,271	980,660	306,954	52,692	4,388,736	7,300,331
	1974		254,477	1,219,411	1,073,728	304,124	41,380	5,230,658	8,123,778
	1976		309,259	1,452,848	1,329,228	276,960	45,338	6,349,078	9,762,711
percentage	1951		4.42	20.73	15.75	3.87	0.53	54.67	100.00
	1962		4.30	21.46	16.92	4.44	0.69	52.28	100.00
	1970		3.58	18.94	12.45	4.20	0.72	60.12	100.00
	1974		3.13	15.01	13.21	3.74	0.51	64.39	100.00
	1976		3.17	14.88	13.62	2.84	0.46	65.03	100.00

Source: "Taiwan Agricultural Yearbook" 1977, Department of Agriculture and Forestry, Provincial Government of Taiwan.

Figure 2

The Map of Taiwan



2. Structure:

The increase in hog production in Taiwan is attributed to the change in the production systems and structure. As the economy developed in the sixties and seventies, hog production became a specialized major operation replacing the former sideline patterns. Rapid increase in the growth rate is evidence of improvement in breeding and feeding technology. As shown in Table 8, growing indexes of average slaughter weight of hogs and ratio of hogs slaughtered to pigs born are evidences of improvement in feeding technology. Number of pigs born per sow annually was 8 in 1953 and 21 in 1973, showing significant progress in hog breeding technique*. The percentage of hogs commercially slaughtered to hogs fed was 35 percent in 1953 and 60 percent in 1973.

In the early period of hog production, farmers raised hogs in the so-called "saving-type" way. Food scraps and feed residuals were a substantial portion of the ration. Characteristics of early hog raising, thus, were described as small-scale operations with low feed conversion efficiency and little response to prices and commercial market condition. Before 1962, 90 percent of the farmers who raised hogs did so under sideline production condition.

After 1962, the government sponsored production improvement plan and increased market demand accompanying economic growth and increased consumer incomes resulted in substantial change in techniques of hog production. The most important changes were new breeds produced from crosses of domestic and foreign breeds; expanded use of concentrate feedstuff, shortening growing periods; and the adoption of new techniques of husbandry.

* Calculated from "Taiwan Agricultural Yearbook" 1977, Department of Agriculture and Forestry, Provincial Government of Taiwan.

Table 8

Average slaughtered weight and ratio of hogs slaughtered to pigs born annually in Taiwan, 1952-1976.

period	average slaughter	weight	hogs slaughter/pigs born	
	Kg	Index	Percent	Index
1952	75	100.00	60.51	100.00
1953	77	102.67	81.19	134.18
1954	76	101.33	83.56	138.09
1955	78	104.00	85.06	140.57
1956	77	102.67	85.13	140.68
1957	82	109.33	84.27	139.27
1958	84	112.00	93.91	155.20
1959	85	113.33	94.44	156.07
1960	85	113.33	90.32	149.26
1961	84	112.00	99.86	165.03
1962	83	110.67	116.56	192.63
1963	83	110.67	108.75	179.72
1964	88	117.33	96.23	159.03
1965	90	120.00	90.34	149.30
1966	90	120.00	91.83	151.76
1967	91	121.33	100.83	166.63
1968	91	121.33	98.16	162.22
1969	96	128.00	95.40	157.66
1970	91	121.33	101.60	167.91
1971	91	121.33	94.35	155.92
1972	94	125.33	75.58	131.52
1973	90	120.00	98.29	162.44
1974	91	121.33	113.23	187.13
1975	94	125.33	86.09	142.27
1976	93	124.00	91.72	151.58

Source: (1) "Taiwan Agricultural Yearbook" 1977, Department of Agriculture and Forestry, Provincial Government of Taiwan.
 (2) "Taiwan Statistical Data Book" 1975, Economic Planning Council, Executive Yuan, Republic of China.

Since 1962 the following major changes in the hog industry have occurred:

- (1) There has been a decrease in the number of farmers raising hogs,
- (2) a sharp increase has occurred in imports of corn and soybeans (see Table 9),
- (3) producer motivation for hog raising changed from saving to profit pursuit,
- (4) operations became more efficient and more sensitive to price changes than before and,
- (5) size of producing unit has increased.

The period from 1962 to 1970 was a period of change from the traditional to the modern system of operation. Since 1971 the number of small scale operation has continued to reduce sharply and large scale operations have increased. The average number of head per operator increased from 4.02 in 1963 to 8.17 in 1974. Table 10 shows an increasing concentration of hog production. The percentage of large-scale operators (over 50 head annually) to total operators was 1.56 percent in 1974. Those operators accounted for 40.74 percent of total production in the same year (see Table 10). The degree of industry concentration has shifted upward and this will affect competition in markets and the distribution of income.

Traditional operations and those commercial operations producing less than 50 head annually were classified as small-scale operations by the Provincial Department of Agriculture and Forestry (PDAF). Commercial hog-raising companies and farmers under the promotion of the integrated hog production program were classified as large-scale operators if they raised over 50 head annually. It is noted that the number of small-scale operators and the number of hogs they raised were reduced each year, 1972 through 1974 (see Table 10).

Table 9

Import of corn and soybean, Taiwan, 1952-1974, at current prices.
(Unit:NT\$ million)

PERIOD	CORN	SOYBEAN
1952	0	75
1953	0	187
1954	0	210
1955	0	228
1956	- *	277
1957	-	300
1958	-	244
1959	-	345
1960	3	517
1961	3	636
1962	6	278
1963	15	789
1964	72	743
1965	221	771
1966	168	792
1967	357	1752
1968	844	1773
1969	947	2099
1970	1669	2946
1971	1543	2748
1972	3265	3864
1973	4865	6201
1974	6459	5879

* "-" represents an amount less than NT\$ 1 million.

Source: MOF (Ministry of Finance)

"Taiwan Statistical Data Book" 1975, Economic Planning
Council, Executive Yuan, Republic of China.

Table 10

Number, index and percentage of hogs produced in Taiwan 1972, 1973 and 1974 by size of production unit.

Item Year	Total		Under 50 head		Over 50 head	
	operator	1000 head	operator	1000 head	operator	1000 head
Number						
1972	519,651	3,831	514,760	3,007	4,891	825
1973	444,020	3,638	437,854	2,504	6,166	1,133
1974	344,832	2,838	339,455	1,692	5,377	1,156
Index						
1972	100.00	100.00	100.00	100.00	100.00	100.00
1973	85.45	94.95	85.06	83.30	126.07	137.46
1974	66.36	74.07	65.94	55.93	109.94	140.18
Percent						
1972	100.00	100.00	99.06	78.48	0.94	21.52
1973	100.00	100.00	98.61	68.84	1.39	31.16
1974	100.00	100.00	98.44	59.26	1.56	40.74

Sources: (1) "Report of PDAF's Survey of Hog Raising", Data are Dec. 31 of 1972 and Nov. 30 of 1973 and 1974.

(2) "Policies of Pork Prices in Taiwan" C.Y. Chang, 1975, Department of Agricultural Economics, National Chung Hsin University, P.11

According to the survey by PDAF in July 1974, 98.56 percent of total producers provided only 62.95 percent of total production while 1.44 percent produced 37.05 percent (see Table 11 and Figure 3). Large-scale producers are playing an important role in total hog supply. Currently, the hog industry is a coexistent situation of large companies and small farm operators. As previously discussed, there is a trend toward large-scale production with large producers expected to originate an increasingly larger portion of total supply. For the purpose of maintaining market competition and preventing the appearance of monopoly, appropriate controls should be considered.

3. Production cost:

As professor Kou^{*} point out increased use of commercially supplied feed has resulted in a dominant position of purchased feeds in variable operating costs under current (1976) patterns of hog production in Taiwan. The results of this situation are as follows:

(a) Operators not only confront the risks of price flexibility in the hog market but also risks of abrupt changes in the price of feedstuffs. Large operators have been better able to shift the risk of price change in feed markets than have the small farmers. Hence, small farmers must accept more price risk than large operators. Large commercial operators usually have contracts with feed companies at guaranteed prices so that feed price risks are transferred through contract arrangements not available to small farmers.

(b) As operators have changed from their traditional feedstuff (largely sweet potato) to concentrated feed, cost of purchased feed has become a major outlay. In the short run, the elasticity of supply of hogs produced by large

* "Production and Supply of Hog in Taiwan" Kou, Y. C. March, 1976. National Chung Hsin University, Department of Agricultural Economics, P.P.41-47.

Table 11

Size distribution of hog-raising production unit in Taiwan, 1974.

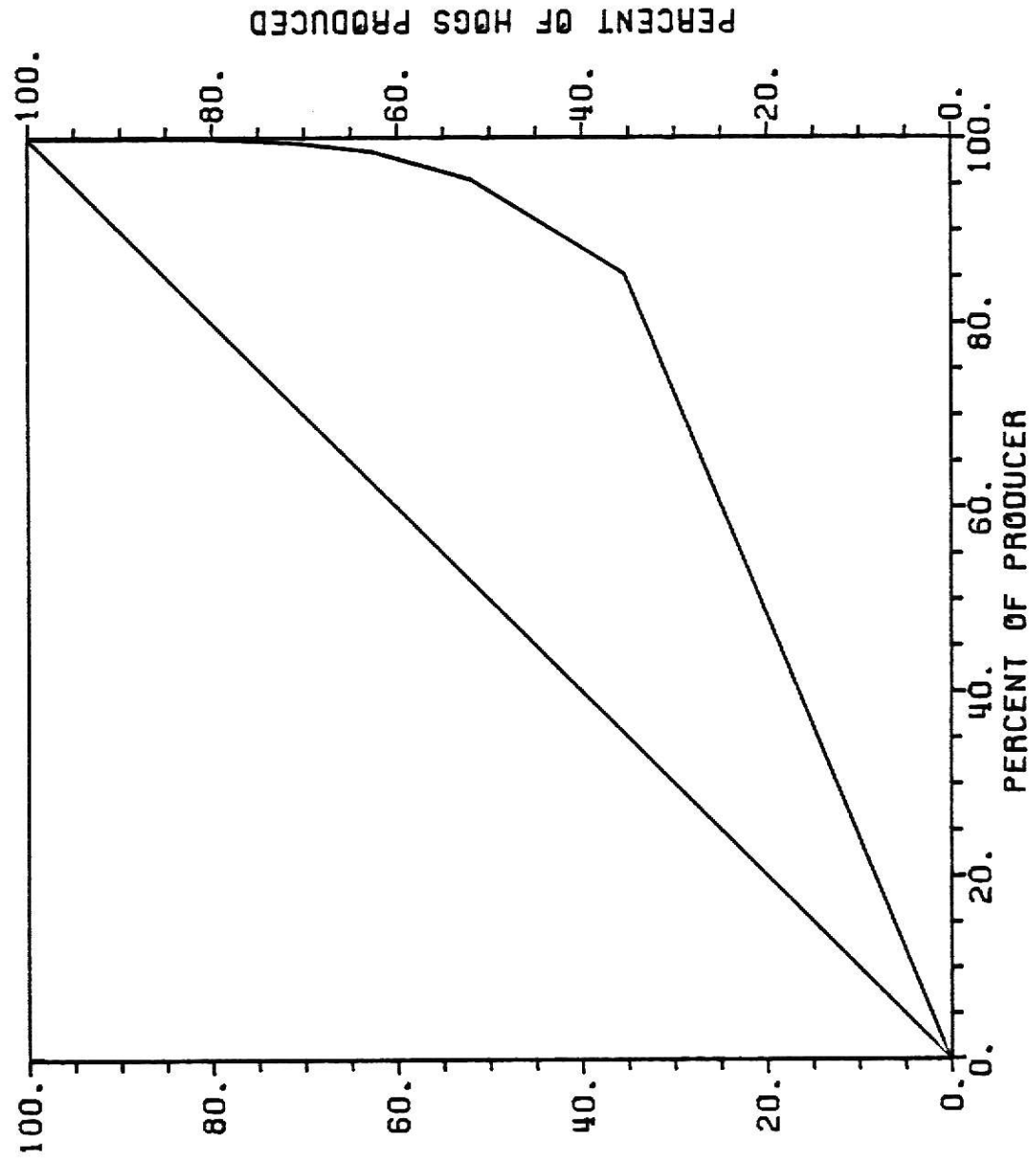
Head raised annually	Farm families		Number of hog		
	family	percent	cumulative %	head	percent cumulative %
under 9	320,511	85.27	85.27	1,038,775	35.32
10 - 20	38,413	10.22	95.49	489,237	16.64
20 - 50	11,530	3.07	98.56	322,149	10.99
50 - 100	3,585	0.95	99.51	231,329	7.87
100- 200	1,125	0.30	99.81	151,857	5.16
200- 300	297	0.08	99.89	71,194	2.42
300- 500	196	0.05	99.94	74,218	2.52
500-1000	116	0.03	99.97	76,593	2.61
1000-5000	59	0.02	99.99	111,715	3.80
over 5000	28	0.01	100.00	372,569	12.67
Total	375,860	100.00	100.00	2,940,636	100.00

Sources: (1) "Report of PDAF's Survey of Hog Raising", July 1974.

(2) M. M. Wu, "Competition Between Commercial Hog Companies and Individual Operators" 1975, Department of Agricultural Economics, National Chung Hsin University.

FIGURE 3

TAIWAN HOG PRODUCER AND NUMBER OF HOGS
RAISED BY ANNUAL PRODUCTION, JULY 1974.



operators becomes less because of feed contracts. However, small operators have become more price sensitive than under traditional production practices and perhaps have a more elastic supply response than the large operators. Fixed cost occupy a small portion of total cost for all producers than in the past, hence, operators are able to adjust scale of output as market situations change. Elasticity of supply is larger than formerly. A larger elasticity of supply will, ceteris paribus, contribute to greater cyclic movement of production and prices.

(c) Production cycle:

There are cyclic movements of hog production and price in Taiwan as elsewhere. Hwang^{*} found that production cycles in Taiwan were related to the ratio of pork price and feedstuff prices. As there were some unaccounted external factors affecting the cycle, it was inefficient to do production planning by examining production cycles because cyclic movements are unstable. In Hwang's research, the period of the cycle had a tendency to shrink as production technology advanced. Rate of gain increased and hence the production period per hog became shorter as new techniques were adopted. Based on the survey of the PDAF, the average number of days required to attain market weight declined from 265 days in the early period (1964) to 185 days in a more recent time (1971).

B. Demand

In recent years, owing to the rapid industrial and commercial growth, per capita income has increased rapidly and, thus, people improved their living standard and health by consuming more animal protein. Pork played an important

* "Analysis of Production Cycles of Hogs in Taiwan" Quarterly Journal of Bank of Taiwan, Vol. 22, No. 3

role in meeting this requirement (see Table 5). January is the peak month of the year for hog slaughter as indicates in Table 12 and February is the lowest. January retail pork prices are the highest and July prices the lowest as indicated in Table 12 by the index of seasonal price variation for the period 1950 to 1974. High demand in January is related to celebration of the Chinese New Year in January. This results in increased consumption of pork and higher prices. Consumption in February, as represented by hog slaughter, is the lowest of the year which can be attributed to over consumption in January which makes people lose their appetite. July usually is the hottest month of the year. The desire for consuming meat is decreased, resulting in lower levels of hog slaughter and seasonally low retail prices for pork.

Demand for pork for domestic consumption in Taiwan is influenced by two main factors (1) growth in per capita consumer disposable income and (2) the availability of competing meats. A third significant demand factor in the market for Taiwan pork has been growth in the export market.

1. Growth in Income

As per capita income in Taiwan has increased (per capita real income, 1971=100, was NT\$9,292 in 1964 and NT\$15,612 in 1974), people not only consumed a larger quantity of pork but also selected pork of better quality. As shown in the report of the PDAF, average price (adjusted) of excellent meat was NT\$48.70 per kilogram in 1964, increasing to NT\$56.97 per kilogram in 1974 (17 percent increase). Within the same period, upper meat increased from NT\$38.91/kg to NT\$43.16/kg (11 percent increase); medium meat from NT\$32.31/kg to NT\$34.01/kg (5 percent increase); lower meat decreased from NT\$19.29/kg to NT\$18.67/kg (4 percent decrease); lard decreased from NT\$27.48/kg to NT\$21.64/kg (21 percent decrease)*.

* "Consumption and Demand for Pork in Taiwan" Shen, S. L. 1976, National Chung Hsin University, Department of Agricultural Economics, PP. 19-21.

Table 12

Index of seasonal variation (percent of annual averages) in number of hogs slaughtered and in retail prices of pork, Taiwan, 1950 to 1974.

Month	Number of hogs slaughtered	Retail price
January	118.64	109.18
February	89.11	107.61
March	93.63	106.16
April	98.45	99.55
May	96.17	96.19
June	98.11	96.19
July	95.11	95.86
August	107.98	98.10
September	96.41	99.44
October	98.66	100.11
November	102.34	98.44
December	105.39	93.17
Standard deviation	7.44	4.83

Source: "Economic Analysis of Hog Industry in Taiwan" C.Y. Lee
1976, Department of Agricultural Economics, National
Chung Hsin University. P.16

With economic growth, population of urban areas has increased and that of the northern area of Taiwan also increased relative to the south so that urban and northern portions of Taiwan have become the main consumption areas.

2. Supply of competing meats

Substitute foods for pork are poultry, beef, lamb and fish. In recent year, consumption of poultry has increased a great amount as consumer incomes have increased but it has also been competitive with pork (see Table 5). Consumption of beef and lamb has increased only slightly as domestic production increased only a very small amount.

Fish production increased most sharply among all major agricultural products (see Table 13). Using 1952 as the base year, the index of fish production was 616.2 in 1974. A comparable livestock production index number is 420.1 and for crops 206.5. Table 5 shows per capita consumption of fish was larger than combined red meat and poultry consumption. It is well known that fish, as well as pork, have contributed a great amount of animal protein in the Chinese diets. Poultry and fish are major substitutes for pork in Taiwan food purchases and hence are important determinants of the retail price of pork.

3. Pork exports

Up to the present time, over 95 percent of all the hogs raised in Taiwan have been used for domestic consumption^{*}, only a small part being exported.

Taiwan's hog export business started with exports to Hong Kong in 1955. All exports were transported as live hogs. Two principal problems arose in the early years of exportation. First, the Hong Kong market was unstable,

* " Long-Term Projection of Supply, Demand and Trade for Selected Agricultural Products in Taiwan", Chang, T. T. in 1970, College of Agriculture, National Taiwan University, P. 133.

Table 13

Agricultural production ---index number (base year:1952=100).

Period	General index	Agriculture (crops)	Forestry	Fisheries	Livestock
1952	100.0	100.0	100.0	100.0	100.0
1953	109.5	108.4	102.0	102.7	123.8
1954	111.8	109.2	107.6	122.7	126.0
1955	112.5	107.6	113.3	141.6	130.8
1956	121.0	116.8	107.1	151.9	139.6
1957	129.8	123.5	124.1	167.6	156.0
1958	138.5	130.4	141.9	171.9	175.0
1959	140.9	130.0	181.9	183.2	173.6
1960	142.8	132.1	188.7	190.8	167.8
1961	155.3	141.9	215.3	219.5	185.7
1962	159.3	143.8	220.7	228.1	201.5
1963	159.6	141.9	219.8	245.4	206.6
1964	178.7	159.7	271.7	267.0	219.4
1965	190.5	172.7	277.3	277.8	225.6
1966	196.5	175.1	255.8	318.9	250.2
1967	208.7	182.4	260.3	360.5	285.1
1968	222.7	189.9	274.5	451.4	305.9
1969	221.0	182.2	258.9	493.0	327.8
1970	233.3	191.0	271.1	515.1	360.1
1971	236.4	191.2	283.3	540.5	366.3
1972	242.1	193.3	265.4	578.9	390.8
1973	253.9	195.2	250.7	646.5	454.9
1974	256.0	206.5	231.7	616.2	420.1

Source: "Taiwan statistical Data Book" 1975, Economic Planning Council,
Executive Yuan, Republic of China.

partly because of unexpected and random dumping of pork from mainland China. Price expectations were unstable in the short run. Second, it was hazardous to transport live hogs by ocean transport over long distances. Death loss in transit was very high. These problems are still encountered in exporting hogs to Hong Kong.

In 1959, Provincial Supply Bureau and Taiwan Sugar Company had exported live hogs to Japan cooperatively. Owing to long distance and difficulties caused during transportation, the two agencies exported frozen pork to Japan instead of live hogs in the next year. Before 1968, there were only very small amounts of frozen pork exported to Japan and quantities varied greatly from year to year. After 1968, because Japanese domestic production of pork could not meet their increasing requirement, exports to Japan from Taiwan increased but large annual variation in export amounts remained. At present, Hong Kong and Japan are the only two foreign markets. Live hog export was highest in 1959 when 94,465 head were exported. Frozen pork export was initiated in 1960 but did not become an important factor until 1968. In 1974, Taiwan exported 54,078 head of live hogs. Frozen pork exports were 11,106 metric tons or the pork equivalent of 288,761 head. Exports in 1974 in live-hog equivalent were roughly 81 percent frozen pork and 19 percent live-hogs and in value terms 92 percent frozen pork and 8 percent live hogs (see Table 14). Domestic markets must first be adequately supplied before export markets can be expanded. From the historical information, it is hard to estimate a trend in export quantity as quantities have been too unstable to project the future demand.

Table 14

Exports of live hogs and pork from Taiwan, Annually, 1955 through 1974.

Period	Exports of live hogs		Exports of frozen pork		Total US\$ Value
	head	weight (M.T)	value (US\$)	Head* weight (M.T) value (US\$)	
1955	8,516	649	116,061	-	116,061
1956	27,126	2,073	643,099	-	643,099
1957	22,588	1,870	597,054	-	597,054
1958	64,169	5,131	1,102,666	-	1,102,666
1959	94,465	7,905	2,542,276	-	2,542,276
1960	76,042	6,921	2,239,885	151	2,341,781
1961	77,165	5,690	1,989,258	1	1,989,258
1962	50,370	4,022	1,406,895	-	1,406,895
1963	18,982	1,827	643,466	100	716,457
1964	10,043	691	241,097	17	254,267
1965	7,258	574	286,259	10	193,929
1966	6,485	513	216,459	-	216,459
1967	16,384	1,346	604,539	1	605,484
1968	8,929	731	289,501	1,002	1,692,259
1969	15,646	1,262	453,815	6,156	8,598,683
1970	45,654	2,572	1,217,905	4,812	6,607,171
1971	24,455	1,221	645,012	2,126	3,564,815
1972	20,309	1,493	788,005	13,205	21,214,178
1973	42,363	5,227	3,694,278	38,275	79,284,162
1974	54,078	2,453	2,210,696	11,106	28,523,465

Source: "Economic Analysis of Hog Industry in Taiwan" C. Y. Lee, 1976, Department of Agricultural Economics, National Chung Hsin University, P.24.

* Head of exports of frozen pork is calculated from weight, 1 M.T. = 24 heads before 1973, 1 M.T. = 26 heads in 1973 and 1974.

IV. Factors Affecting Pork Prices

The previous section discussed both the demand and the supply side for pork. In this section demand and supply factors especially relevant to the price of pork will be examined. Figure 4 shows a diagram of the pork economy of Taiwan.

A. Personal disposable income

As the economy has grown, national income has increased more rapidly than population and consequently per capita income has increased. Table 15 shows that national real income increased from NT\$ 64,504 million in 1952 to NT\$ 246,437 million in 1974; real personal disposable income shifted up from NT\$ 4,745 in 1952 to NT\$ 13,270 in 1974. Annual population growth rates were over 3 percent before 1963 and over 2 percent from 1963 to 1971. Because of high population growth rates per capita disposable income, although increasing, did not increase as much as national income.

A developing country, usually, has a high income elasticity of demand for food. This has been the case in Taiwan. Pork prices in Taiwan are affected by change in per capita personal disposable income which increased in real terms by 82 percent in ten years, 1965 through 1974.

B. Consumption of fish and poultry

Taiwan is rich in fish and is under a favorable condition for developing fishery. Since the implementation of a series of economic development plans by the government in 1953, fishery output has increased from 121,697 M.T. in 1952 to 810,600 M.T. in 1976; the average annual growth rate is between 9 and 10 percent, showing an increase of more than 6 times within 24 years. Big vessels, new equipment and modern fishery techniques have contributed to tre-

Figure 4

Structure of the pork industry in Taiwan

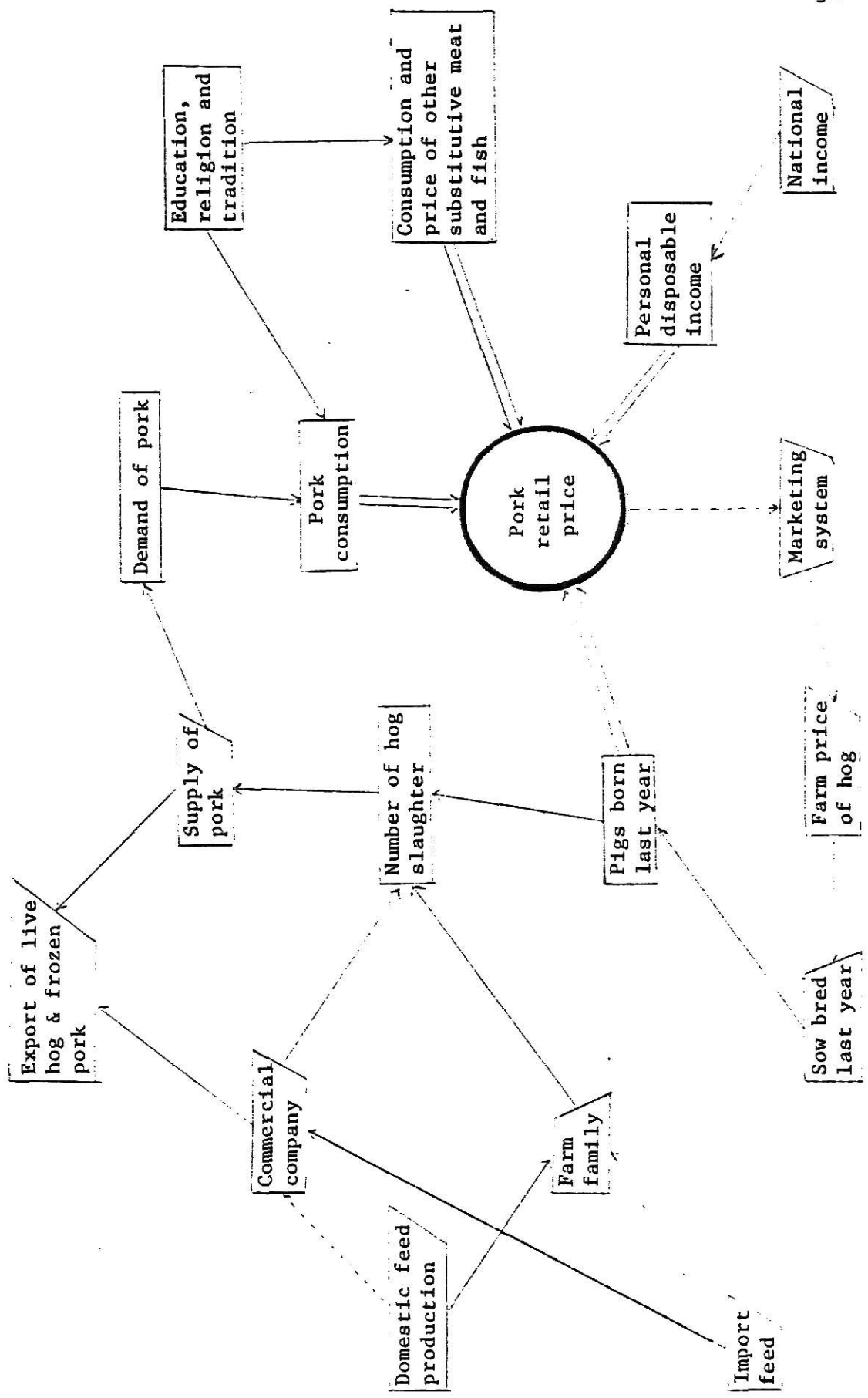


Table 15

Real value of national income, per capita income, and per capita personal disposable income. (adjusted at 1971 price).

Period	National real income	Per capita real income	Per capita personal disposable income.
	(NT\$ million)	(NT\$)	(NT\$)
1956	64,504	6,567	4,554
1957	68,556	6,766	4,745
1958	71,552	6,841	5,084
1959	76,505	7,080	5,080
1960	80,717	7,236	5,227
1961	86,414	7,508	5,636
1962	91,267	7,697	5,737
1963	101,797	8,337	5,883
1964	116,770	9,290	6,533
1965	122,728	9,493	7,260
1966	131,932	9,932	7,729
1967	145,590	10,692	8,435
1968	156,203	11,201	8,966
1969	166,842	11,697	9,474
1970	185,420	12,710	10,653
1971	206,816	13,863	12,078
1972	227,282	14,927	13,063
1973	249,547	16,088	13,402
1974	246,437	15,612	13,270

Source: "Taiwan Statistical Data Book" 1975, Economic Planning Council, Executive Yuan, Republic of China.

mendous expansion of fishery production. Fish consumption, therefore, is larger than that of total meat and poultry and is about 1.5 times consumption of pork.

Poultry raising has long been a popular subsidiary business among most households of Taiwan, especially in the rural area. Chickens and ducks are by far the most important poultry enterprises, while geese and turkeys are kept primarily for family consumption.

Beginning in 1963, the government introduced the "Integrated Improvement Program in Chicken Production" in order to encourage the development of this particular primary industry. Under the program, cooperation between government agencies and farmers has speeded the development of the poultry industry.

So far as government policies were concerned, there has been no public action to assist in the raising of ducks. Only a few government extension workers have informed farmers about the use of new methods of management and about technologies of raising improved breeds. Notwithstanding the little support from government, duck production has increased and has contributed to meeting the increased demand for meat. Poultry consumption has increased rapidly and has occupied an increasing percentage of total meat consumption (see Table 5). Poultry is one of the important substitutes for pork in Taiwan households.

C. Consumption of pork

It is well known that consumption and prices are closely related. A change of prices will cause a inverse change in consumption. A change of consumption will cause change in prices in the same direction. Per capita consumption of pork has increased greatly over the past two decades, however, pork consumption as a percentage of total meat consumption has decreased from

86.69 percent in 1956 to 73.79 percent in 1974 (see Table 5).

As expressed in the previous chapter, people increased their consumption of meats to obtain more animal protein and to improve their health. Although pork consumption did not increase as much as poultry or fish consumption, national pork consumption in 1977 was double that of 1956. As relative price goes up, consumption will go down. The price/quantity relationship is negative. Thus, it is expected that we will get a negative sign when the parameter or pork consumption independent of demand shifts is related to price of pork.

D. Prices of poultry and fish

Fish price changes will have an effect on pork consumption and pork prices. It is expected that historical price/consumption data will show that fish consumption has a positive relation to pork price. Poultry price will have the same effect and relationship to pork price. These relationships will be examined in next chapter. The weighted average price of fish and poultry will be considered with other factors affecting retail price of pork.

E. Pigs born in last year

From 1952 to 1965, 265 days were required for finishing hogs to reach market weight. From 1966 to 1970 the time required to reach market weight declined to 228 days and continuously declined to 185 days in 1975. The decline is attributed largely to the new method of management and the introduction of improved hybrids. Pigs born last year is the best available indicator of changes in current supply of hogs. In the past with a farrowing to finishing period approaching one year, pigs born last year have affected current year pork prices. However, as the feeding period shortens and greater cyclic movement in farrowings occurs, this statistic will be less applicable

to price analysis in the future.

If number of pigs born last year increased, supply of hog in the current year will increase and result in downward pressure on the price of pork. Changes in supply of pork will normally have an inverse effect on pork prices. Historically, pork prices have increased in Taiwan with production increases because of shifts in demand that have occurred at the same time. However, if the price effects of demand shifts can be separately accounted for it is expected that the supply/price relationship will be a negative one.

F. Exports and other factors

Exports of pork or live hogs have some influences on the domestic supply, and it could be an adjustment outlet when there is an over supply condition in the domestic market and active demand from the foreign market. In Taiwan, although exports have occupied only a small part of total production in the past few year, they should not be ignored. If prices in foreign market are high enough to cover all the extra costs of transportation, businessmen will export hogs at a profit. If exported amounts are large, this will cause an increases in domestic pork prices. To extend exports it is necessary to stablize domestic supply and prices. In the next chapter, although exports would not be concerned as an affecting variable they do have some effects on domestic pork supply and pork prices. Because export volumes have fluctuated and hence are difficult to project, exports will not be treated explicitly in a statistical model at this time.

Traditional customs will affect people's appetites for pork and other meats. For instance, some rural people will not eat beef as historically cattle offered power for cultivation. Religion will affect pork consumption and prices, for example, Buddhists are prohibited to eat meat. In addition,

the present education and public propaganda or advertisement also have some influence on consumption and prices of pork.

V. Statistical Model

A. Correlation coefficients between retail price of pork and factors affecting price.

Factors affecting retail price of pork were discussed in the previous chapter. Simple regression analysis relating various independent variables to the dependent variable, retail price of pork, produced the following results:

(1) Real per capita personal disposable income

The calculated result from Table 16, showing the relationship between real per capita disposable income and pork retail price adjusted for price level changes is:

$$Y = 14.377550 + 0.000558X_1, \text{ where}$$

(0.000070)	$R^2 = 0.7894$
(0.0001)	$F = 63.72$

Y represents pork retail price per pound in NT\$.

X_1 represents per capita personal disposable income in NT\$.

Standard error is in the upper parenthesis.

Probability of failing to reject H_0 : parameter = 0 is in the lower parenthesis.

The coefficient of determination, R^2 , is significant at 1 percent level under the F-test. The Beta coefficient of X_1 is 0.000558 which is significant at 1 percent level under the t-test. The above result shows that per capita disposable income did affect pork retail prices.

(2) Pigs born last year

Statistical result of the relationship between pork retail price and pigs born last year is:

Table 16

Data for Pork Price Model, Taiwan, 1956-1974.

	Y	X ₁	X ₂
period	pork retail prices*	personal disposable per capita income*	pigs born last year
	(NT\$/lb.)	(NT\$)	(1,000 head)
1956	16.94	4,554	2,082
1957	16.82	4,745	2,268
1958	16.34	5,084	2,475
1959	17.20	5,080	2,527
1960	17.84	5,227	2,388
1961	17.55	5,636	2,369
1962	16.71	5,737	2,432
1963	16.81	5,883	2,237
1964	17.61	6,533	2,358
1965	19.06	7,260	2,644
1966	19.18	7,729	2,983
1967	19.43	8,435	3,284
1968	20.55	8,966	3,412
1969	20.95	9,474	3,595
1970	20.43	10,653	3,809
1971	22.07	12,078	4,252
1972	22.76	13,063	4,652
1973	20.27	13,402	5,702
1974	19.95	13,270	5,904

* All values had been adjusted by general wholesale price index, 1971=100.

Source: Calculated from

- (1) "Taiwan Statistical Data Book" 1975, Economic Planning Council, Executive Yuan, Republic of China.
- (2) "Production and Operation of Foodstuff Produce in Taiwan" 1975, Taiwan Provincial Food Bureau.
- (3) "Statistical Monthly Report of Prices in Taiwan" 1975, Ministry of Economic Affairs, Executive Yuan, Republic of China.

$$Y = 14.745289 + 0.001276X_2, \text{ where}$$

$$\begin{array}{ll} (0.000266) & R^2 = 0.5757 \\ (0.0002) & F = 23.06 \end{array}$$

X_2 represents number of pigs born last year.

It is noted that R^2 is significant at 1 percent level under F-test and the regression coefficient is also significant at 1 percent level under t-test.

(3) Weighted average retail price of poultry and fish

The equation of their relationship from Table 16 and 17 is:

$$Y = 11.078022 + 1.064888X_3, \text{ where}$$

$$\begin{array}{ll} (0.103071) & R^2 = 0.8626 \\ (0.0001) & F = 106.74 \end{array}$$

X_3 represents the weighted average retail prices of fish and poultry

The above result shows that there is a significant relationship between retail price of fish and poultry and retail prices of pork.

(4) Per capita pork consumption

The calculated equation from Table 16 and Table 17 is:

$$Y = 11.045331 + 0.228675X_4, \text{ where}$$

$$\begin{array}{ll} (6.73) & R^2 = 0.7269 \\ (0.0001) & F = 45.24 \end{array}$$

X_4 represents per capita pork consumption.

A positive relationship between price of pork and consumption of pork is indicated, suggesting that annual change in average consumption of pork is dominated by demand shifts, probably increase in per capita income, rather than the expected price/quantity relationship.

(5) Combined per capita poultry and fish consumption

The equation is:

Table 17

Data for Pork Price Model, Taiwan, 1956-1974.

	X_3	X_4	X_5
period	weighted average price of fish and poultry.*	per capita pork consumption.	combined consumption of fish and poultry.
	(NT\$/lb.)	(lb.)	(lb.)
1956	5.92	24.85	44.56
1957	6.05	27.82	45.99
1958	6.02	24.85	48.85
1959	6.70	28.11	50.11
1960	6.54	25.75	50.86
1961	5.91	28.31	58.93
1962	5.37	29.41	61.44
1963	5.15	28.11	63.89
1964	5.54	28.95	66.03
1965	6.27	30.27	65.55
1966	7.47	33.18	72.69
1967	8.28	37.02	74.54
1968	8.95	37.43	77.94
1969	9.34	38.40	79.01
1970	9.32	42.15	87.70
1971	9.89	42.22	90.48
1972	10.44	44.29	93.69
1973	9.07	47.77	95.83
1974	6.74	45.19	90.54

* All values had been adjusted by general wholesale price index, 1971=100.

Source: Calculated from

- (1) "Economic Analysis of Hog Industry in Taiwan" C.Y. Lee, 1976, Department of Agricultural Economics, National Chung Hsin University, p.8.
- (2) "Food Balance Sheet" 1975, Joint Commission on Rural Reconstruction.
- (3) "Production and Operation of Foodstuff Produce in Taiwan", 1975, Taiwan Provincial Food Bureau.
- (4) "Taiwan Statistical Data Book" 1975, Economic Planning Council, Executive Yuan, Republic of China.

$Y = 11.811965 + 0.101653X_5$, where

$$\begin{array}{ll} (0.012831) & R^2 = 0.7869 \\ (0.0001) & F = 62.76 \end{array}$$

X_5 represents combined per capita poultry and fish consumption.

The last two equations show that the consumption of three kinds of meat and their relation to pork price are significant. As these three kinds of meat are concerned, consumption trends also have very close relationships. Their correlation coefficients are very high.

(6) Relation between pork consumption and combined consumption of poultry and fish.

The calculated result from Table 17 is:

$$\begin{array}{ll} X_4 = 6.115137 + 0.404725X_5 & \\ (0.033203) & R^2 = 0.8973 \\ (0.0001) & F = 148.58 \end{array}$$

The above finding indicate that there is a positive relationship between pork consumption and combined consumption of poultry and fish. The reason is that Taiwan, as a developing country possessing a high income elasticity of demand for food^{*}, especially meat, thus, consumption for each of the three kinds of meat will not replace each other but will increase together as per capita income increases.

B. Building a multiple regression model for historical trend

If we treat pork retail prices as the dependent variable (Y) and treat other affecting factors as independent variables (X_a), fitting a multiple regression model will include the following variables.

* "The Economics of Agricultural Development", Mellor, John W. Cornell University Press, Ithaca & N.Y. 1974, PP. 78

- Y : pork retail price.
 X_1 : per capita personal disposable income.
 X_2 : pigs born in last year.
 X_3 : weighted average price of poultry and fish.
 X_4 : per capita pork consumption.
 X_5 : per capita combined consumption of poultry and fish.

Table 18 is the correlation coefficient matrix table of dependent variable (Y) and other independent variables (X_a). Correlation coefficient between Y and X_3 is 0.92877, the highest one between Y and X_a , indicates X_3 and Y have a highest positive relationship as simple regression model is concerned.

Four procedures of building multiple regression models will be used in this section. They are forward selection procedure, backward elimination procedure, stepwise regression procedure and all possible regression procedure. Brief reviews of them are listed below.

(a) Forward selection procedure

Forward selection procedure is involves inserting variables in turn until the model is determined by using the partial correlation coefficient as measure of the importance of added variables*.

(b) Backward elimination procedure

Backward elimination procedure compares the partial F-test value to a preselected significance level F -table value. If partial F-test value is smaller than F-table value, the variable is removed from consideration and the regression equation recomputed using, in turn, each of the remaining variables and further comparion of partial F-test value to F-table value, etc. When partial F-test value is bigger than the F-table value the regression

* "Applied Regression Analysis", Draper and Smith, John Wiley & Son, Inc. 1966, P. 169.

Table 18

Correlation coefficient matrix table

	Y	X ₁	X ₂	X ₃	X ₄	X ₅
Y	1.00000	0.88848	0.75873	0.92877	0.85357	0.88705
X ₁	-	1.00000	0.95758	0.78741	0.97709	0.96816
X ₂	-	-	1.00000	0.67235	0.95116	0.88003
X ₃	-	-	-	1.00000	0.81266	0.77991
X ₄	-	-	-	-	1.00000	0.94728
X ₅	-	-	-	-	-	1.00000

Y: Pork retail price.

X₁: Per capita personal disposable income.X₂: Pigs born in last year.X₃: Weighted average price of poultry and fish.X₄: Per capita pork consumption.X₅: Per capita combined consumption of poultry and fish.

Source: Calculated from Table 16 and Table 17.

equation has been determined*.

(c) Stepwise regression procedure

By using partial F-test value to re-examine all entered variables at any stage, stepwise regression procedure selects the significant variables into consideration and removes those non-significant variables. This process is continued until no more variables will be admitted to the equation and no more are rejected**.

(d) All possible regression procedure

This procedure considers all the possible regression models, therefore, a high-speed computer is needed. The criterion is the value of residual mean square, adopting the least residual mean square equation as the proper model is the only selection process.

By using forward selection procedure, the model is:

$$Y = 15.235832 + 0.000929X_1 - 0.000526X_2 + 0.722106X_3 - 0.224972X_4 + 0.003951X_5.$$

(0.000282)	(0.000499)	(0.120128)	(0.074320)	(0.030645)
(0.0058)	(0.3107)	(0.0001)	(0.0097)	(0.8994)

$$R^2 = 0.9765 \qquad F = 108.07$$

By using backward elimination procedure, the model is:

$$Y = 15.314358 + 0.000960X_1 - 0.000576X_2 + 0.714399X_3 - 0.220280X_4.$$

(0.000138)	(0.000308)	(0.100473)	(0.062485)
(0.0001)	(0.08220)	(0.0001)	(0.0034)

$$R^2 = 0.9765 \qquad F = 145.29$$

By using stepwise regression procedure, the model is:

$$Y = 10.491311 + 0.693510X_3 + 0.047593X_5.$$

(0.121007)	(0.012094)	$R^2 = 0.9302$
(0.0001)	(0.0012)	$F = 106.59$

* "Applied Regression Analysis", Draper and Smith, John Wiley & Sons, Inc. 1966 PP. 167-168.

** Ibid., PP. 171-172

Table 19 shows the residual mean squares of all possible models. By using all possible regression procedure we select the model with least residual mean square, which is:

$$Y = 15.314358 + 0.000960X_1 - 0.000576X_2 + 0.714399X_3 - 0.220280X_4.$$

$$\text{Residual mean square} = 0.115841 \quad R^2 = 0.9765 \quad F = 145.29$$

As the above results show, a model omitting the X_5 variable is selected by two methods of model building. It is selected as the appropriate model and used to express the relationship between pork retail price and those affecting factors. The equation tells us that increases in per capita personal disposable income and increases in weighted average retail price of poultry and fish are associated with increases in the average retail price of pork. Increases in numbers of pigs born last year as a proxy for pork supply and annual per capita pork consumption had a negative association with pork retail price. Ninety-eight percent of the variation in annual average price of pork was associated with variations in these four factors in the historical period 1956 through 1974.

C. Pork price projection

The findings of the multiple regression model are used to project future prices, utilizing the predictive value of the dependent variables. From their historical data we could calculate their trends in each of the variables and calculate their future values. Estimating equations for projected values of independent variables are as follows:

$$X_1 = 2,709.0702 + 533.3508t \quad R^2 = 0.9283$$

$$X_2 = 1,385.8246 + 184.4333t \quad R^2 = 0.7954$$

$$X_3 = 5.0656 + 0.2249t \quad R^2 = 0.5495$$

$$X_4 = 22.0749 + 1.2129t \quad R^2 = 0.8750$$

t represents time period (1955=0).

Table 19

Residual mean square of all possible regression models.

Dependent variable	Independent variable	Residual mean square
Y	X ₁	0.854141
Y	X ₂	1.720894
Y	X ₃	0.557162
Y	X ₄	1.107649
Y	X ₅	0.864376
Y	X ₁ X ₂	0.476679
Y	X ₁ X ₃	0.311936
Y	X ₁ X ₄	0.884535
Y	X ₁ X ₅	0.857887
Y	X ₂ X ₃	0.450215
Y	X ₂ X ₄	1.053625
Y	X ₂ X ₅	0.909230
Y	X ₃ X ₄	0.470622
Y	X ₃ X ₅	0.300831
Y	X ₄ X ₅	0.912063
Y	X ₁ X ₂ X ₃	0.204096
Y	X ₁ X ₂ X ₄	0.498558
Y	X ₁ X ₂ X ₅	0.417028
Y	X ₁ X ₃ X ₄	0.135186
Y	X ₁ X ₃ X ₅	0.313059
Y	X ₁ X ₄ X ₅	0.888752
Y	X ₂ X ₃ X ₄	0.480011
Y	X ₂ X ₃ X ₅	0.317196
Y	X ₂ X ₄ X ₅	0.907505
Y	X ₃ X ₄ X ₅	0.266539
Y	X ₁ X ₂ X ₃ X ₄	0.115841
Y	X ₁ X ₂ X ₃ X ₅	0.437265
Y	X ₁ X ₃ X ₄ X ₅	0.125595
Y	X ₂ X ₃ X ₄ X ₅	0.212429
Y	X ₁ X ₂ X ₃ X ₄ X ₅	0.124593

Y, X₁, X₂, X₃, X₄, X₅ represent the same factor indicated in Table 18.
 Source: Calculated from Table 16 and Table 17.

As "t" value equaled to twenty-four for 1979, the projected value of each independent variable, basing on the above equations, was listed in the first row in Table 20. By inserting those projected values of affecting factors into the selected regression model, $Y=15.314358 + 0.000960X_1 - 0.000576X_2 + 0.714399X_3 - 0.220280X_4$, the predictive retail price of pork was calculated and listed in the last column in Table 20.

Table 20

Projected value of those affecting factors and
pork retail price, 1979-1985.

Year	X_1^*	X_2	X_3	X_4	Y
1979	15,509	5,812	10.46	51.18	23.05
1980	16,043	5,997	10.68	52.40	23.35
1981	16,576	6,181	10.90	53.61	23.64
1982	17,110	6,366	11.13	54.82	23.94
1983	17,643	6,550	11.35	56.04	24.25
1984	18,176	6,734	11.58	57.25	24.54
1985	18,710	6,919	11.80	58.46	24.84

Values in Column six are the predicted values of
the pork retail prices from 1979 to 1985 in deflated
1971 NT\$.

* Y, X_1 , X_2 , X_3 , X_4 represent the same factor
indicated in Table 18.

VI. Summary and Conclusion

(a) Hog raising is one of the major incomes of farmer in the rural area. Although the percentage of farm income from raising hogs decreased to 37.85 percent in 1976, it has contributed a big share to the progress of the farm economy and agricultural development. Pork is a main supplier of meat and animal protein to people living in Taiwan, flexibility of pork retail price will affect consumers' welfare and producers' profit, and it will also affect the prices of other commodities.

(b) Location of feed production has tended to concentrate in the southern part of Taiwan which has caused hog raisers to locate in the southern part also. Feedstuff is the main variable cost. Most of the concentrated feed was imported. Stabilizing import feed cost and developing domestic production of feed are important goals in promotion of hog production as well as stabilization of the pork industry.

(c) Income has increased rapidly in Taiwan. With increased income, demand for pork has increased rapidly. Demand for high quality meat has increased. Price of high quality pork has gone up relative to that of lard and low quality pork.

(d) The structure of the pork industry is shown in Figure 4. There are many factors affecting pork retail price as we discussed in chapter 4 and we can get a comprehensive concept of this study from Figure 4.

(e) Exports have not been very important in past years. Only a small part of the produce was exported, however, attention should be paid to exports because of the potential outlet for future development.

(f) The multiple regression model based on historical trend explained a high proportion of past average annual price variations. The model we built

from the historical information demonstrated a positive relationship between pork retail price and per capita personal disposable income and between pork retail price and weighted average retail price of poultry and fish. Pigs born last year and pork consumption had an inverse relation to pork retail price. Combined consumption of poultry and fish was omitted from the model because it does not possess a significant relationship to pork retail price.

(g) Projection of future prices based on the relationships established in the multiple regression model indicate a steady increase in real average annual prices of pork in Taiwan through 1985.

BIBLIOGRAPHY

- Lee, C. Y. "Economics Analysis of Hog Industry in Taiwan", Department of Agricultural Economics, National Chung Hsin University, 1976
- Department of Agriculture and Forestry, "Taiwan Agricultural Yearbook", Provincial Government of Taiwan, Republic of China, 1977
- Economic Planning Council, "Taiwan Statistical Data Book", Executive Yuan, Republic of China, 1975
- Ministry of Economic Affairs, "Statistical Monthly Report of Price in Taiwan", Executive Yuan, Republic of China, 1975
- Mellor, John W. "The Economics of Agricultural Development", Cornell University Press, Ithaca & New York, 1974
- Ferris, John "Factors Affecting Cattle Prices", North Central Regional Extension Publication No. 25, July 1969
- Breimyer, Harold F. "Demand and Price for Meat", USDA, Tech. Bulletin, 1253, 1961
- Waite, Warren C. & Cox, Rex W. "Seasonal Variations of Prices and Marketings of Minnesota Agricultural Products, 1921-1935", University of Minnesota Agricultural Experiment Station, October 1937
- Chang, C. Y. "Policies of Pork Prices in Taiwan". Department of Agricultural Economics, National Chung Hsin University, 1975
- Wu, M. M. "Competition Between Commercial Hog Companies and Individual Operators", Department of Agricultural Economics, National Chung Hsin University, 1974
- Shen, S.L. "Consumption and Demand for Pork in Taiwan", Department of Agricultural Economics, National Chung Hsin University, 1976
- Chang, T. T. "Long-Term Projection of Supply, Demand and Trade for Selected Agricultural Products in Taiwan", College of Agriculture, National Taiwan University, 1970
- Kou, Y. C. "Production and Supply of Hog in Taiwan", Department of Agricultural Economics, National Chung Hsin University, 1976
- Hwang, Y. H. "Analysis of Production Cycles of Hogs in Taiwan", Journal of Bank of Taiwan, Vol. 22, No.3

Provincial Food Bureau, "Production and Operation of Foodstuff Produce in Taiwan", Provincial Government of Taiwan, Republic of China, 1975

Department of Agriculture and Forestry, "Report of Farm Booking", Provincial Government of Taiwan, Republic of China, 1975

Joint Commission on Rural Reconstruction, "Food Balance Sheet", 1975

Hwang, C. J. "An Research of Hog Market in Taiwan", Joint Commission on Rural Reconstruction, Vol. 16, Dec. 1974

Department of Agricultural Products Wholesale Market Yearbook", Provincial Government of Taiwan, Republic of China

Draper, N. R. & Smith H. "Applied Regression Analysis", John Willey & Sons, Inc., New York, 1966

FACTOR AFFECTING PORK PRICE IN TAIWAN

by

MING HONG CHOW

B.S., College of Chinese Culture, 1975
Taipei, Taiwan

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Agricultural Economics

KANSAS STATE UNIVERSITY

Manhattan, Kansas

1979

ABSTRACT

Pork is an important and influential meatstuff to people living in Taiwan. The objective of this study is to identify major factors that affect pork retail price and to predict future trend of pork retail price.

Much of the information used in this report was obtained from public reports of official government departments of the Republic of China; some data were taken from recent economic studies of the pork industry.

By reviewing historical data, the supply and demand conditions for pork and those factors affecting supply and demand were evaluated. Multiple regression analysis was employed to measure the effect of each factor on the price. All values used or predicted in this study had been adjusted to real term by the general wholesale price index with base year, 1971.

Pork production has tended to increase in the southern part of Taiwan island. Large-scale producers have played an important role in the changing structure of hog production in recent years. With a farrowing to finishing period approaching one year, pigs born last year was used as an important supply variable and a main factor affecting hog supply.

Demand for pork in Taiwan is influenced by two main factors (1) growth in per capita consumer disposable income and (2) the availability of competing meat. Owing to the rapid industrial and commercial growth, per capita income has increased sharply in the recent historical period. Since the implementation of a series of economic development plans and improvement programs for chicken production, competing meat, fish and poultry, provide increasing competition to pork.

Fluctuating volume of export of live hog and frozen pork was reported. Although exports of pork occupied only a small portion of total production and fluctuated greatly, it still has the ability of adjusting outlet when excess supply appeared. Exports will not be concerned explicitly in the statistical model at this time but it should not be ignored.

The selected multiple regression model is:

$$Y = 15.314358 + 0.000960X_1 - 0.000576X_2 + 0.714399X_3 - 0.220280X_4, \text{ where}$$

$$(0.000138) \quad (0.000308) \quad (0.100473) \quad (0.062485)$$

$$(0.0001) \quad (0.0822) \quad (0.0001) \quad (0.0034)$$

$$R^2 = 0.9765$$

$$F = 145.29$$

Y represents pork retail price.

X_1 represents per capita personal disposable income.

X_2 represents pigs born in last year.

X_3 represents weighted average price of poultry and fish.

X_4 represents per capita pork consumption.

X_5 represents per capita combined consumption of poultry and fish.

This model yields a very high multiple regression coefficient ($R^2 = 0.9765$), and all the concerned factors have significant effects at the 0.1 level of confidence. The model, built from the historical information, demonstrated a positive relationship between pork retail price and per capita personal disposable income and between retail price and weighted average retail price of poultry and fish. Pigs born last year and pork consumption show an inverse relationship to pork retail price.

From employing four kinds of model building procedure, all those models we got explained a high proportion of past average annual price variation (R^2 values are all above 90 percent).