CHINA'S IMPORT DEMAND FOR WHEAT

BY

HAIGUANG SHI

A Thesis
Submitted to the Faculty of Graduate Studies
in Partial Fulfillment of the Requirements
for the Degree of

MASTER OF SCIENCE

Department of Agricultural Economics and Farm Management
University of Manitoba
Winnipeg, Manitoba

ISBN 0-612-13502-0

Name Haiguang Shi

Dissertation Abstracts International is arranged by broad, general subject categories. Please select the one subject which most nearly describes the content of your dissertation. Enter the corresponding four-digit code in the spaces provided.

Demand, Trade, Wheat, China Social Sciences

SUBJECT TERM

0503

SUBJECT CODE

U·M·I

Subject Categories

THE HUMANITIES AND SOCIAL SCIENCES

COMMUNICATIONS AND THE ARTS

- Architecture 0729
- Art History 0377
- Cinema 0900
- Dance 0378
- Fine Arts 0357
- Information Science 0723
- Journalism 0391
- Library Science 0399
- Mass Communications 0708
- Music 0413
- Speech Communication 0459
- Theater 0465

EDUCATION

- General 0515
- Administration 0514
- Adult and Continuing 0516
- Agricultural 0517
- Art 0273
- Bilingual and Multicultural 0282
- Business 0688
- Community College 0275
- Curriculum and Instruction 0727
- Early Childhood 0518
- Elementary 0524
- Finance 0277
- Guidance and Counseling 0519
- Health 0680
- Higher 0745
- History of 0520
- Home Economics 0278
- Industrial 0521
- Language and Literature 0279
- Mathematics 0280
- Music 0522
- Philosophy of 0998
- Physical 0523
- Psychology 0525
- Reading 0535
- Religious 0527
- Sciences 0714
- Secondary 0533
- Social Sciences 0534
- Sociology of 0340
- Special 0529
- Teacher Training 0530
- Technology 0710
- Tests and Measurements 0288
- Vocational 0747

LANGUAGE, LITERATURE AND LINGUISTICS

- Language
  - General 0679
  - Ancient 0289
  - Linguistics 0290
  - Modern 0291
- Literature
  - General 0401
  - Classical 0294
  - Comparative 0295
  - Medieval 0297
  - Modern 0298
  - African 0316
  - American 0591
  - Asian 0305
  - Canadian (English) 0352
  - Canadian (French) 0355
  - English 0593
  - Germanic 0311
  - Latin American 0312
  - Middle Eastern 0315
  - Romance 0313
  - Slavic and East European 0314

PHILOSOPHY, RELIGION AND THEOLOGY

- Philosophy 0422
- Religion
  - General 0318
  - Biblical Studies 0321
  - Clergy 0319
  - History of 0320
  - Philosophy of 0322
- Theology 0469

SOCIAL SCIENCES

- American Studies 0323
- Anthropology
  - Archaeology 0324
  - Cultural 0326
  - Physical 0327
- Business Administration
  - General 0310
  - Accounting 0272
  - Banking 0770
  - Management 0454
  - Marketing 0338
- Canadian Studies 0385
- Economics
  - General 0501
  - Agricultural 0503
  - Commerce-Business 0505
  - Finance 0508
  - History 0509
  - Labor 0510
  - Theory 0511
- Folklore 0358
- Geography 0366
- Gerontology 0351
- History
  - General 0578
  - Ancient 0579
  - Medieval 0581
  - Modern 0582
  - Black 0328
  - African 0331
  - Asia, Australia and Oceania 0332
  - Canadian 0334
  - European 0335
  - Latin American 0336
  - Middle Eastern 0333
  - United States 0337
- History of Science 0585
- Law 0398
- Political Science
  - General 0615
  - International Law and Relations 0616
  - Public Administration 0617
- Recreation 0814
- Social Work 0452
- Sociology
  - General 0626
  - Criminology and Penology 0627
  - Demography 0938
  - Ethnic and Racial Studies 0631
  - Individual and Family Studies 0628
  - Industrial and Labor Relations 0629
  - Public and Social Welfare 0630
  - Social Structure and Development 0700
  - Theory and Methods 0344
- Transportation 0709
- Urban and Regional Planning 0999
- Women's Studies 0453

THE SCIENCES AND ENGINEERING

BIOLOGICAL SCIENCES

- Agriculture
  - General 0473
  - Agronomy 0285
  - Animal Culture and Nutrition 0475
  - Animal Pathology 0476
  - Food Science and Technology 0359
  - Forestry and Wildlife 0478
  - Plant Culture 0479
  - Plant Pathology 0480
  - Plant Physiology 0817
  - Range Management 0777
  - Wood Technology 0746
- Biology
  - General 0306
  - Anatomy 0287
  - Biostatistics 0308
  - Botany 0309
  - Cell 0379
  - Ecology 0329
  - Entomology 0353
  - Genetics 0369
  - Limnology 0793
  - Microbiology 0410
  - Molecular 0307
  - Neuroscience 0317
  - Oceanography 0416
  - Physiology 0433
  - Radiation 0821
  - Veterinary Science 0778
  - Zoology 0472
- Biophysics
  - General 0786
  - Medical 0760

EARTH SCIENCES

- Biogeochemistry 0425
- Geochemistry 0996
- Geodesy 0370
- Geology 0372
- Geophysics 0373
- Hydrology 0388
- Mineralogy 0411
- Paleobotany 0345
- Paleoecology 0426
- Paleontology 0418
- Paleozoology 0985
- Palynology 0427
- Physical Geography 0368
- Physical Oceanography 0415

HEALTH AND ENVIRONMENTAL SCIENCES

- Environmental Sciences 0768
- Health Sciences
  - General 0566
  - Audiology 0300
  - Chemotherapy 0992
  - Dentistry 0567
  - Education 0350
  - Hospital Management 0769
  - Human Development 0758
  - Immunology 0982
  - Medicine and Surgery 0564
  - Mental Health 0347
  - Nursing 0569
  - Nutrition 0570
  - Obstetrics and Gynecology 0380
  - Occupational Health and Therapy 0354
  - Ophthalmology 0381
  - Pathology 0571
  - Pharmacology 0419
  - Pharmacy 0572
  - Physical Therapy 0382
  - Public Health 0573
  - Radiology 0574
  - Recreation 0575
  - Speech Pathology 0460
  - Toxicology 0383
- Home Economics 0386

PHYSICAL SCIENCES

Pure Sciences

- Chemistry
  - General 0485
  - Agricultural 0749
  - Analytical 0486
  - Biochemistry 0487
  - Inorganic 0488
  - Nuclear 0738
  - Organic 0490
  - Pharmaceutical 0491
  - Physical 0494
  - Polymer 0495
  - Radiation 0754
- Mathematics 0405
- Physics
  - General 0605
  - Acoustics 0986
  - Astronomy and Astrophysics 0606
  - Atmospheric Science 0608
  - Atomic 0748
  - Electronics and Electricity 0607
  - Elementary Particles and High Energy 0798
  - Fluid and Plasma 0759
  - Molecular 0609
  - Nuclear 0610
  - Optics 0752
  - Radiation 0756
  - Solid State 0611
- Statistics 0463

Applied Sciences

- Applied Mechanics 0346
- Computer Science 0984
- Engineering
  - General 0537
  - Aerospace 0538
  - Agricultural 0539
  - Automotive 0540
  - Biomedical 0541
  - Chemical 0542
  - Civil 0543
  - Electronics and Electrical 0544
  - Heat and Thermodynamics 0348
  - Hydraulic 0545
  - Industrial 0546
  - Marine 0547
  - Materials Science 0794
  - Mechanical 0548
  - Metallurgy 0743
  - Mining 0551
  - Nuclear 0552
  - Packaging 0549
  - Petroleum 0765
  - Sanitary and Municipal 0554
  - System Science 0790
- Geotechnology 0428
- Operations Research 0796
- Plastics Technology 0795
- Textile Technology 0994

PSYCHOLOGY

- General 0621
- Behavioral 0384
- Clinical 0622
- Developmental 0620
- Experimental 0623
- Industrial 0624
- Personality 0625
- Physiological 0989
- Psychobiology 0349
- Psychometrics 0632
- Social 0451

CHINA'S IMPORT DEMAND FOR WHEAT

BY

HAIGUANG SHI

A Thesis submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

ABSTRACT

Wheat accounts for more than 50 percent of the world's traded grain. The volume of wheat trade varies annually according to buying and supplying patterns of few large wheat importers and exporters. China is one of the largest wheat importers in the world. While China's fluctuating patterns of wheat imports bring some uncertainties to the world wheat market, a more thorough understanding of China's wheat import patterns and future demand appears important.

This study provides an empirical analysis of China's wheat import patterns based on statistical data from 1961 to 1990. Several short-run and long-run models were employed to derive the empirical patterns of China's wheat trade operations and effects of exogenous variables on the pattern. Demand is forecasted with a long-run distributed-lag model for the period of 1991 to 2000.

The major statistically significant factors affecting the level of China's wheat imports are found to be: China's foreign trade balance, real income per capita, trade policy, the currency exchange rate, total domestic grain output, and domestic transportation capacity. China's projected annual wheat imports by the year 2000 are 28 million and 38 million metric tons in low and high growth scenarios respectively.

Study shows that China's increasing real income per capita, trade surplus, increasing total grain output, and supportive trade policy positively affect import demand while the depreciation of Chinese currency and insufficient transportation capacity affect it negatively.

The results of the best long-run model, which contains variables of lagged import demand, foreign trade balance, real income per capita, trade policy impact, total grain output, exchange rate, and transportation capacity, indicate that China's wheat imports are elastic to exchange rate, total grain output, and domestic grain transportation capacity. The transportation capacity elasticity of 2.4 is the highest. The long-run model has a high R^2 value of 0.95 and a desirable Durbin-Watson value of 2.03.

The results suggest that China's import demand for wheat has a statistically significant pattern. The projected imports for the 1990s indicate an increasing trend of wheat imports for China. However, the import volumes projected by this study are lower than the projections of similar studies.

ACKNOWLEDGEMENTS

I would like to express my sincerest thanks to Dr. M.H. Yeh, my major academic advisor, for his guidance, continued encouragement and support through my entire graduate program.

I also would like to thank Professor R.M. Josephson and Dr. E.S. Rosenbloom, my thesis committee members, for their constructive advice, comments, and time spent on reading this thesis.

Special thanks to MacDonald's family for their kind friendship, financial support, and continued encouragement during the entire course of my program.

Finally, I feel greatly indebted to my parents, whose generous family support made my program possible.

This thesis is dedicated to Mr. Ed Buchik in memory of his invaluable friendship, generosity, and great guidance.

TABLE OF CONTENTS

	Page
ABSTRACT	iv
ACKNOWLEDGEMENTS	vi
LIST OF FIGURES	x
LIST OF TABLES	xi
LIST OF ABBREVIATIONS	xii
1. INTRODUCTION	1
1.0 General Introduction	1
1.1 Statement of the Problem	3
1.2 Objectives of the Study	4
1.3 Organization of the Study	5
1.4 Agricultural and Wheat Regions in China	6
1.5 Grain Production and Consumption in China	10
1.5.0 Characteristics of Chinaś Grain Production and Consumption	10
1.5.1 Wheat Production in China	12
1.5.2 Wheat Consumption	15
1.6 Literature Review	16
2. BACKGROUND OF CHINA'S GRAIN SUPPLY AND WHEAT TRADE (1961-1990)	21
2.0 Impact of Domestic Agricultural Policy on Grain Production and Supply	21

2.1 China's Wheat Import History 25

2.2 China's Grain Trading System 27

3. COMCEPTUAL FRAMEWORK 31

3.0 Theoretical Framework 31

3.0.0 Demand and Supply of Grain and Wheat 32

3.0.1 Policy Consideration 38

3.0.2 Conceptual Framework 39

3.1 Specification of Important Variables 41

3.2 Methods of Analysis 42

3.3 Assumptions and Hypotheses 46

3.4 Data 47

4. EVALUATION AND INTERPRETATION OF THE EMPIRICAL RESULTS 49

4.0 Evaluation of the Short-run Model Results 49

4.1 Evaluation of the Long-run Model Results 53

4.2 Interpretation of the Results 54

4.3 Forecasting Future Import Demand (1991-2000) 64

4.3.0 Forecast Explanatory Variables 64

4.3.1 Forecast Future Import Demand 70

5. SUMMARY AND IMPLICATIONS 73

5.0 Summary of the Study 73

5.1 Implications and Issues 75

REFERENCES 81

APPENDIX 85

LIST OF FIGURES

		Page
1.1	China's Agricultural Region	7
3.1	China's Grain Demand and Supply	37

LIST OF TABLES

		Page
1.1	Regional Distribution of Sown Area in China, 1987	8
1.2	Regional Share of Nation's Production by Crop in China, 1987	9
1.3	Regional Share of Main Crops in China, 1987	10
1.4	China Wheat Yield, Supply and Demand	14
3.1	Food Consumption per Family based on Income, 1990	33
3.2	Percentage of Income Expenditure on Food, 1985-1990	34
3.3	Relative Share (%) of Food and Feed Grain, 1970-1988	35
4.1	Results of Linear Regression	50
4.2	Results of Log-Linear Regressions	51
4.3	Results of Distributed Models	53
4.4	Estimated Grain Output between 1991 and 2000 (1,000 tons)	69
4.5	Forecasted Wheat Demand between 1991 and 2000	71

LIST OF ABBREVIATIONS

CEROILFOOD	China National Cereals, Oils, and Foodstuffs Import and Export Corporation
COSCO	China Ocean Shipping Corporation
EEC	European Economic Community
ERS	Economic Research Service
FAO	Food and Agriculture Organization
GATT	General Agreement on Tariffs and Trade
GGB	Government Grain Bureau
GNP	Gross National Product
USDA	United States Department of Agriculture

CHAPTER 1

INTRODUCTION

1.0 General Introduction

Wheat trade is one of the major activities in the world grain market. In the 1991 - 1992 crop year, 108.2 million tons of wheat were traded, which accounted for 20 percent of the world total wheat production and 54 percent of its total grain traded respectively[1].

The prices and traded volume in the world wheat market depend highly on the behaviour of a few large wheat importing countries. China is currently the world's largest wheat consumer and one of the largest wheat importers. In 1990, China imported 12.5 million tons of wheat. China's wheat imports have accounted for nearly 10 percent of the world traded volume of wheat annually between 1960 and 1990[2]. The volume of China's wheat import, however, has fluctuated widely over the last three decades. The domestic agricultural performance is the government's main consideration in determining levels of wheat imports. China's agriculture supports 21.5 percent of the world population with only 6.97 percent of the world arable land[3]. In 1990, it produced 99 million tons of

---

[1]USDA, ERS, World grain situation and outlook, (Washington DC, December, 1992), 31-32.

[2]China Statistics Bureau, China Statistical Yearbook, 1991, (Beijing: China Statistics Publishing House).

[3]Ibid., 819-820.

wheat[4]. Although China is currently the largest wheat producer in the world, its output has never met the actual demand from the fast growing population. Imports of wheat from other countries, therefore, have been an important way to overcome the shortage of domestic wheat supply. During the pre-reform period from 1961 to 1978, China's annual wheat imports fluctuated between 2 million tons and 8 million tons per year. After the agricultural reforms were launched in 1978, the wheat imports were decreased to 5.63 million tons by 1985 due to increased domestic grain output. Imports reached a record high level of 14.55 million tons in 1987 due to the ever increasing growing population and the crop failure between 1985 and 1987.

The growing importance of China's wheat trade in the world wheat market since the late 1970s has prompted a great deal of research. Much was aimed at deriving quantitative frameworks to project future wheat import requirements. Such research, however, was often difficult due to unawareness of China's secretive decision-making process for grain imports, frequent changes in trade policies for imports, and limited statistical data. As a result, the forecasted high volume wheat imports were often inconsistent with China's actual volume of imports. A thorough understanding of China's import patterns, therefore, appears important for prediction of future wheat demand. Neoclassical economic analysis of China's wheat demand is insufficient because the demand is not purely market determined. Instead, a political economy approach should be considered as well in understanding the decision-making process which underlies China's purchases of wheat on the world market.

---

[4]Ibid.

This study examines China's past purchasing patterns and decision-making processes, reveals the impact of influential factors, and also develops a framework to forecast China's future wheat demand. Previous studies focused on the impact of China's population, grain shortage, and limited foreign exchange reserves. This study also takes into account, besides the above factors, the impact of the recent policy reforms, transportation capacity, increasing income, foreign currency exchange rate, and Chinese potential future agricultural production.

1.1 Statement of the Problem

Wheat imports by China are internationally recognized issues because China is the largest wheat consumer in the world. The large imports of wheat by China have shown a substantial impact on the world wheat market since 1978 and challenged the stability of world wheat prices. However, China's wheat imports did not attract a notable amount of research until the early 1980s due mainly to China's isolation from the western world during the 1960s and the early 1970s. Statistical data and related economic information were not widely available to western researchers during that period. It was commonly believed that China was not able to access many wheat export sources and the wheat imports were rigid when China had a ideological confrontation with the western countries. However, China's wheat imports varied and shifted from one exporter to another rapidly during the 1970s. The rapid shift captured much attention of researchers in the late 1970s and the early 1980s. Since then China's wheat imports have become a frequently debated and controversial topic for many research professionals.

Many researches on estimation of China's import demand with common economic variables, such as the level of domestic production, the size of China's population, and the relative prices of various grains, have not been very successful. The transportation constraints and policy impact were main neglected factors in the previous studies. Scarce data sources also impeded appropriate application of desired theoretical frameworks in estimation and forecast.

China's wheat import pattern has been influenced dramatically by the reforms in China's agriculture. Changes in grain output resulted from the reform frequently shifted trade policies as China's trade practices are usually guided by the domestic self-sufficiency policy. Impact of continual agricultural reforms, therefore, becomes an important consideration in the study of wheat trade pattern and projection of future import demand.

China's target grain output for the year 2000 was set at 500 million metric tons by the Chinese government to meet the self-sufficiency goal. Much of the concerns have resulted in the question being asked whether China is able to achieve this goal, and whether there will still be any import demand for wheat once this target output is eventually reached.

1.2 Objectives of the Study

This study is designed to answer some of the above-mentioned unsolved questions, to examine the real driving mechanism of China's wheat imports from both supply and demand perspectives, and to forecast future demand based on a more consistent data set,

desired empirical models, and consideration of recent policies.

The specific objectives of this study can be described as follows:

1. To make an overall review of China's wheat economy, trade policy issues, and the related problems in its agricultural sector.

2. To develop appropriate empirical models for the estimation of China's wheat import demand with consideration of recent economic reforms.

3. To forecast China's import demand for wheat between 1991 and 2000, and to discuss the implications suggested by the study.

1.3 Organization of the Study

This study is presented in the following five chapters:

Chapter 1 introduces the Chinese agricultural regions, grain and wheat production, consumption, and trade situation. It also presents a statement of the problem, objectives of this study and a review of the related studies.

Chapter 2 presents the historical background of China's wheat trade and depicts the current situations of major components involved in wheat imports such as trade policy and pricing systems.

Chapter 3 discusses the conceptual frameworks and important variables used in this study based on characteristics of the wheat trade and China's economic situation. Assumptions, hypotheses, and brief description of data used in the study are also given in this chapter.

Chapter 4 presents all empirical results of this study and evaluations of the short-

run and long-run models, and also forecasts the import demand between 1991 and 2000.

Chapter 5 concludes this study by summarizing findings and pointing out implications.

The Appendix lists all tables, data used in the study, and some reference data as well.

The References list selected important references used in the study.

1.4 Agricultural and Wheat Regions in China

To understand China's import demand for wheat, a basic understanding of Chinese agricultural production is necessary. This is because import demand largely depends on Chinese grain yields and harvest volumes. Yields and harvest volumes vary largely from one region to another depending on weather conditions and agricultural development levels. China's major geographical agriculture regions are shown in Figure 1.1.

As sown area and production output vary from year to year, it is necessary to choose an average year's figures to represent each region's performance. For China, 1987 was chosen in Table 1.1, Table 1.2, and Table 1.3 to illustrate regional crop distribution of sown area and crop production.

Table 1.1 shows the total sown area of each region and percentage of sown area for each crop within a region. The sown area represents the importance of each region to the country's grain production. The percentage of sown area to each crop represents the crop contribution to the production within the region.

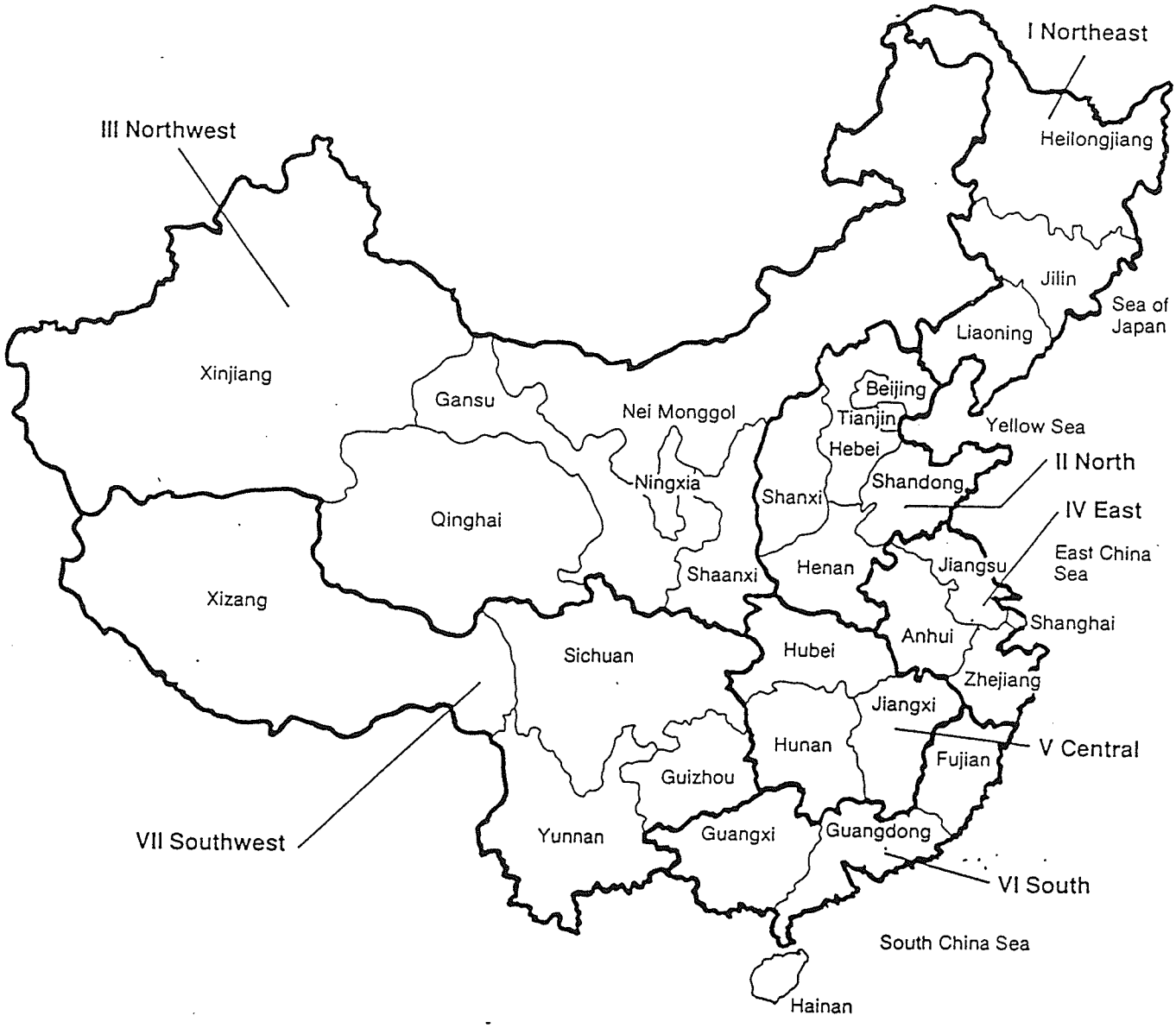

Figure 1.1 China's Agricultural Region

Table 1.1 Regional Distribution of Sown Area in China, 1987

Region	Sown area (1,000 hectare)	Percentage of sown area by crop within each region (%)				
		Rice	Wheat	Corn	Soybean	Other
Northeast	16,173	9.2	10.2	33.6	20.3	26.7
North	36,695	2.0	33.7	19.7	5.9	38.7
Northwest	17,110	1.9	33.2	14.1	3.6	47.2
East	21,917	33.1	20.8	3.8	5.0	37.3
Central	20,295	49.7	7.9	2.5	2.4	37.5
South	13,286	56.8	1.2	4.2	3.1	34.7
Southwest	19,482	24.5	14.1	16.5	2.0	42.9

Source: USDA, ERS, China: Agriculture and Trade Report, (Washington DC, July 1990), 33.

China currently ranks the first in the world in wheat harvested area with 29 million hectares, which accounts for about 14 percent of the world's total wheat sown area[5]. The most important region for wheat production in China is the north region. It has the largest area sown to grains (more than 36 million hectares) and the highest percentage of sown area planted to wheat production (33.7 percent), representing in a total of 12.37 million hectares for wheat production. In the northwest region, the percentage of sown area for wheat is almost as high as in north region, but the sown area for wheat, 5.68 million hectares, is only about half of the wheat sown area of the north region due to its smaller grain sown area. East is another region important to wheat production in

[5]USDA, ERS, World Grain Situation and Outlook, (Washington DC, December, 1992), 25, 32.

China although the most favourable crop in this region is rice. The total sown area for wheat in the east is about 4.56 million hectares. Corn is more popular in the northeast China compared to the rest of country. Rice is primarily concentrated in the south and the central regions.

Table 1.2 presents each region's production share by crop in China's total production output for the year 1987. Table 1.3 shows regional production of 4 main crops in the same year. China's wheat production accounted for about 18 percent of the would's total wheat output[6], among which about 48 percent of the production is contributed by north region. Production is not necessarily parallel to the sown area in the region because it also depends on average yield per hectare. The east region produces more wheat than northwest although the sown area in east is less.

Table 1.2 Regional Share of Nation's Production by Crop in China, 1987
(percentage)

Region	Rice	Wheat	Corn	Soybean
Northeast	5	4	33	44
North	2	48	37	24
Northwest	1	15	11	6
East	25	19	4	14
Central	31	5	2	5
South	20	0	1	3
Southwest	16	9	12	4

Source: USDA, ERS, China: Agriculture and Trade Report, (Washington DC, July 1990), 33.

[6]Ibid.,

Table 1.3 Regional Production of Main Crops in China, 1987
(1,000 tons)

Region	Rice	Wheat	Corn	Soybean
Northeast	8,721	3,511	26,341	5,361
North	3,488	42,129	29,534	2,924
Northwest	1,744	13,165	8,780	731
East	43,604	16,676	3,192	1,706
Central	54,069	4,388	1,596	609
South	34,883	0	798	366
Southwest	27,906	7,899	9,579	487
Total	174,415	87,768	79,820	12,184

Source: USDA, ERS, China: Agriculture and Trade Report, (Washington DC, July 1990), 33.

Distribution of crops tends to vary according to economic returns within geographical and climate limitations such as heat, moisture, and length of frost-free period. The north and central regions are China's most intensely farmed areas with high average yields. Water resources are critical to crop production in these regions as irrigated wheat and wet paddy rice are prominent crops. In the south region, climatic conditions are unfavourable to wheat and corn production. Therefore, wheat for human consumption and coarse grains for animal consumption in this region have to dependent upon supplies either from foreign countries or from northern China.

1.5 Grain Production and Consumption in China

1.5.0 Characteristics of China's Grain Production and Consumption

Chinese grain production and transaction can be described as having large geographic grain-deficient regions, variable yield per hectare between different areas, and slow distribution caused by insufficient transportation capacities. The 170 state commodity grain bases are mainly located in the east, central-south, and north-east China, whereas the north-west and the south-west are the low-yield and grain deficient areas. This uneven development, plus the uneven distribution of grain variety within different regions, has created imbalance between supply and demand for total grains and for particular variety as well. To solve this problem, an active grain trade between provinces is required. However, slow and inadequate transportation and very low state procurement prices limited the inter-provincial grain trade. For many years before the agricultural reforms in 1978, the state purchased only slightly more than 20 percent of the total grain output, half of which was shipped to the grain deficient areas. By 1990, the purchase rate had increased to 36.6 percent of the total grain output. This increase in purchase rates should be considered a result of a significant improvement in inter-provincial grain trade, which is operated under the present government controlled marketing system.

Grain consumptions are considered differently for urban and rural residents in China. Fine grains are usually supplied to urban and government-employed rural residents through state owned grain stores by a rationing system. Other rural residents and non-grain farmers have to purchase food grain from local markets where grain farmers sell their surplus portion of grain after they have delivered their assigned quota to the state. Due to the limitation and the high selling prices of the surplus portion of grain, coarse grain is also consumed as a substitute in some rural areas by both grain and non-grain

farmers. The rationing system limits the supply quantity for urban consumers to balance the supply and demand. The urban consumers, therefore, could not purchase desired quantities of food grain under the government controlled prices. The rationing system distorted the distribution of consumer's and producer's surplus. As a result of more economic reforms in China, the grain rationing system was completely lifted in 1992. The objective of this action was to redistribute the distorted consumer's and producer's surplus share. Grain growers now have more flexibility in making planting decisions and enjoy higher grain prices under the free market system. In the meantime, consumers now have more access to buy better quality grain in free market for consumption within an affordable price range.

During the 1980s, expenditures on food items for urban residents as a proportion of total expenditures (known as the Engel coefficient) exhibited a declining trend[7]. The decline was caused mainly by decreases in the expenditure share on food grain. The increased expenditures on non-staple food, such as edible oil, pork, and eggs, were significant. Annual per capita consumption of these three commodities grew respectively by 147, 49, and 176 percent.

1.5.1 Wheat Production in China

The northeast and northwest spring, north winter, and east winter wheat regions are the main wheat production areas in China. The spring wheat region includes the provinces of Heilongjiang, Jilin, and Liaoning in the north-east; Neimenggu, Qinghai,

---

[7]USDA, ERS, China: Situation and Outlook, (Washington DC, July 1990), 19.

Xinjiang, and Xizang; and most of Gansu, western Sichuan, Shaanxi, Shanxi, and north-western Hebei provinces. The main spring wheat production areas are in Heilongjiang, Neimenggu, and Xinjiang. The spring wheat region is characterized by a dry, cold climate, with very cold winters, a short frost-free period, one annual cultivation and large scale mechanized farming.

The north China winter wheat region accounts for approximately 41.6 percent of total wheat sown and 47 percent of the nation's wheat output in 1990[8]. Shandong, Henan, Hebei, and Shaanxi of this region are the most important wheat-producing provinces in the country. The climate and soil are favourable for wheat production, allowing three crops to be produced every two years. The major problem for wheat production in this region is spring droughts, which are gradually being rectified by improved irrigation systems.

Before the agricultural reforms in 1978, China's wheat yields were ranged between 0.6 metric ton per hectare in 1961 and 1.85 metric tons per hectare in 1978. Following the reforms in 1978 wheat yields rapidly increased to 2.97 metric tons per hectare by 1988, the end of the first reform decade. Table 1.4 shows China's wheat yield, production, consumption, and imports between 1984 and 1992. The yield was further increased to 3.04 tons per hectare by 1990. This dramatic increase has been due to a number of factors including increased use of modern inputs such as chemical fertilizers and pesticides, improved irrigation, cultivation, and production management, and

---

[8]China Statistics Bureau, China's Statistical Yearbook, 1990, (Beijing: China Statistics Publishing House).

increased use of farm machinery.

Table 1.4 China's Wheat Yield, Supply and Demand

Crop year	Wheat Yield (metric tons per hectare)		Production (millions of metric tons)	Net Import (millions of metric tons)	Consumption (millions of metric tons)	Stock Change (Millions of metric tons)
	China	World				
84/85	2.97	2.20	87.8	7.4	92.2	3.0
85/86	2.94	2.15	85.8	6.6	100.4	-8.0
86/87	3.04	2.30	90.0	8.5	101.5	-3.0
87/88	2.98	2.26	85.8	15.0	102.8	-2.0
88/89	2.97	2.28	85.5	15.5	104.4	-3.4
89/90	3.04	2.36	90.8	13.0	104.5	-0.7
90/91	3.19	2.54	98.2	9.5	106.0	1.7
91/92	3.10	2.45	96.0	15.8	110.0	1.8
92/93	3.30	2.51	101.0	10.0	110.5	0.5

Source: USDA, Foreign Agricultural Service, World Grain Situation and Outlook, (Washington DC, December 1992), 25, 32.

As demand for wheat increases, the planted wheat area in China has also increased significantly from 24.08 million hectares in 1962 to 30.75 million hectares in 1990. Paralleled with the increased wheat yield, an impressive growth in wheat production has been brought about, from 14 million metric tons in 1961, to 29 million metric tons in 1970, to 55.2 million metric tons in 1980, and to 98.2 million metric tons in 1990. Opportunities for increased wheat production still exist. However, in recent years the area of newly reclaimed arable land has been less than the area of arable land lost to non-farm

uses due to the fast growing economic development. Further growth likely will have to depend on improving crop yields and reducing the loss in storage and transportation.

In recent years major constraints to wheat production increases have been the lack of funds allocated to agricultural inputs and infra-structure development. Over the past three decades, Chinese agricultural capital investment, as a percentage of the total government budget, has dropped from 17.6 percent in the early 1960s to 3 percent in 1990 while the farm input prices have increased significantly. Prices of inputs, largely manufactured in urban areas, have been allowed to rise as labour and material costs increase. Government purchase prices for farm products have risen more slowly than input costs due to the policy that has kept urban retail prices for grain relatively stable and low. Farmers are caught between these two sets of administered prices, and their profit margins over the past few years have decreased. This loss in profitability has greatly reduced the incentive of farmers in investing in farmland and agricultural inputs.

1.5.2 Wheat Consumption in China

Traditionally wheat was consumed in northern China while rice was mostly consumed in the south. For centuries wheat was only produced in the north and used locally for human consumption. Since the reforms in 1978, an increasing volume of wheat has been shipped down to the southern cities to meet the increasing demand for wheat.

The total wheat use for human consumption in China has increased dramatically since the 1980s. The quantity of wheat used as animal feed is still negligible. Most of the increases in total wheat consumption is a result of increased per-capita consumption of

wheat as food. As income increases, fast food has become popular in urban areas, especially in the south where wheat traditionally is in low demand.

The remarkable growth of China's wheat production has been parallelled by a very rapid increase in this consumption. The increase in consumption has exceeded China's population growth rate, which declined from nearly 3 percent a year in the 1960's to 1.5 percent a year in the 1980s. The precise growth rate of wheat consumption is difficult to estimate as official estimates are not available.

1.6 Literature Review

Most of the early studies done during the 1980s characterized China's wheat trade policy as a political rather than an economic consideration. The typical example would be China's major wheat imports from Canada in the 1960s and 1970s. China's wheat trade started with Canada in 1961 and was indeed initiated through a political and diplomatic approach. As Karen Minden stressed that " China's wheat import policy is an integral part of two policy systems: food policy, and foreign policy"[9] and "In fact the wheat trade is central to Canada's relation with the People's Republic of China.....during the first decade of trade with China, from the time when the Wheat Board "recognized China" in 1961 until the establishment of diplomatic relations in 1971, Canada continued to supply about one third of China's total wheat imports. On average, 19 percent of Canada's annual wheat exports were shipped to China and wheat accounted for about 93

---

[9]Minden, K., Politics and Business: The Canada-China Wheat Trade 1960-1984, (Centre on Foreign Policy and Federalism, 1985), 103.

percent of our total exports to that country ....."[10]. Minden further projected the diplomatic importance of Sino-Canadian wheat trade:" wheat is likely to continue to play a pivotal role in Sino-Canadian relations"[11].

Research conducted by Schwartz and Ralston showed that "government policy plays a heavy role in import decisions, and government policies have shifted frequently ..... China does not appear to be a price-responsive wheat importer"[12]. Halbrendt and Gempesaw, however, argued that "regarding imports, the Chinese authorities were shown to be responsive to world prices, although they were constrained by foreign exchange earnings"[13]. Nevertheless both studies agreed that the impact of China's import on world price and price variability is substantial.

Halbrendt and Gempesaw further forecasted China's future wheat demand for the early 1990s with a very high scenario of "increasing consumption predictions, imports would increase to a record high of 35 million tons"[14]. However, this study excluded the impact of domestic grain policies. As a result of missing important variables, the forecasted wheat demand by Halbrendt and Gempesaw is three times as high as China's

---

[10]Ibid., 6.

[11]Idem., "The Politics of Cerealism: the wheat trade and canadian-Chinese relations", working paper #27, (The joint Centre on Modern East Asia - University of Toronto - York University, 1983), 24.

[12]Schwartz, N.E. and Ralston, K., "The impact of Chinese wheat imports on world price and trade", (Department of Agricultural Economics, Cornell University, 1983), 2, 26.

[13]Halbrendt, C. and Gempesaw, C., "A policy analysis of China's wheat economy", American Journal of Agricultural Economics 72 (1990): 275.

[14]Ibid., 274.

actual purchase. China only purchased 12.5 million tons of wheat in 1990 compared to the estimated quantity of 35 million tons.

Later, researchers paid more attentions to China's domestic agricultural output situation and its impact on wheat demand. Frediric M. Surls studied related factors in China's wheat imports and projected China's wheat import growth as: "If real gross national product (GNP) grows by 6 percent annually (the lower end of current estimates), if the income elasticity of demand for wheat is about 0.5, and if population growth is 1 percent annually as expected, demand for wheat will shift an average 4 percent per year over the next decade"[15].

While many researchers tried to examine the gap between China's supply and demand, Nicholas R. Lardy analyzed China's import decision-making and domestic grain marketing systems. The evidence in the article " China's interprovincial Grain Marketing and Import Demand" showed that there was a great waste of grain in grain surplus regions while China imported large amounts of wheat and interregional grain marketing presented a large controversial problem for grain imports. "The net import of 50 million tons of grain in 1980-83 was partly added to stocks, exacerbating an existing severe storage problem. As a result of the inability to move grain interregionally, huge quantities of grain were wasted in the first half of the 1980's"[16].

---

[15]Surls, F.M., "The Dynamics of China's Wheat Trade", U.S. competitiveness in the world wheat market: proceedings of a research conference, (USDA, ERS, International Economics Division, Washington DC, 1987), 94.

[16]Lardy, N.R., "China's Interprovincial Grain Marketing and Import Demand", (USDA, ERS, 1990), 39.

The reasons for lack of interregional grain transfer were given as " Substantially higher prices paid for inward transfers". "However, if the real constraint in the past has been the limited supply of grain available for transfer, the higher prices received by supplying regions could increase the desired level of interprovincial transfers. Whether the constraints of storage and transport could be eased sufficiently to accommodate that increased level of transfer is not clear"[17].

Researchers re-examined China's self-sufficiency policy to question if China could achieve the target grain output. An article presented by Mr. Joseph R. Goldberg strongly argued that "virtually every projection made in the past five years, whether by Chinese institutes, the FAO, the USDA, or the World Bank, has indicated that China will produce about 500 million tons of Chinese-definition grain in the year 2000[18] and in reality the physical capacity to produce this amount, or anything close to it, will not exist at that time"[19]. Goldberg further pointed out that "Even enormous Chinese imports of these grain, e.g., 60 million tons of maize and 40 million tons of wheat, could probably be handled at real prices, the question here is only the ability and willingness of China to bear such an import bill"[20].

The World Bank conducted a comprehensive study on China's grain production, marketing and imports in 1991. The world Bank pointed out some existing problems and

---

[17]Ibid., 40.

[18]Chinese definition of grain including wheat, coarse grain, and tubers.

[19]Goldberg, J.R., "Grain options for China - 1990-2000", In Agricultural Reform and Development in China, (Beltsville, MD: Ideals, 1990), 115.

[20]Ibid., 122.

made suggestions and projections in this comprehensive study. The study concluded that increased livestock sector's feed demand and growing human demand for wheat and wheat products would require changes in trade patterns. Under more liberalized marketing and foreign trade policies, China would shift from being a net exporter of corn and soybean to a net importer in order to serve domestic demands for feed grains, which would be balanced in part by net exports of rice[21].

In general, all relevant studies indicated that China would continue to import significant volume of wheat in the 1990s, but none of these studies showed convincing quantitative forecast.

[21]World Bank, China: Options for Reform in the Grain Sector, (Washington DC, 1991), viii.

CHAPTER 2

BACKGROUND OF CHINA'S GRAIN SUPPLY AND WHEAT TRADE (1961 - 1990)

2.0 Impact of Domestic Agricultural Policies on Grain Production and Supply

China's domestic food grain supply, which largely determines the quantity of wheat imports, is often influenced by domestic policies in grain pricing, marketing, and agricultural inputs. As a result, the impact of domestic agricultural policies on China's wheat imports can be equally important as the impact of China's foreign trade policies.

The Chinese government imposed a fixed low price system for agricultural products in the 1950s to support its industrialization. Since then, all purchasing and retailing prices were tightly controlled by the government. In 1978, following a ten-year long cultural revolution, the Chinese government decided to launch economic reforms to curb the economic decline, which initially started in the agricultural sector.

The actual agricultural reforms began in 1978 consisted of partial privatization, increase in price incentives, and encouragement for special crop production and marketing. This reform initially had a remarkable effect on farm output and level of productivity. Agricultural output grew by 7.4 percent annually between 1978 and 1984,

a pace almost four times of the long run rate achieved between 1952 and 1978[1]. The record expansion of grain output made it possible to reduce imports of wheat substantially and to increase exports of rice and coarse grains simultaneously, particularly corn. This transformation of China's agricultural trade patterns generated several billion U.S. dollars in foreign exchange savings that were used to increase substantially the imports of capital goods and high technology products.

Much of the increase in agricultural output in this period of the reform was due to significantly improved price incentives and increased marketing opportunities. After the initiation of the reform, a two-tier price system was developed to sell food grain to consumers, an open market price and a government controlled price. Both prices existed at state owned grain stores and only market prices were available at local free markets. In the first few years of the reform, the government controlled prices rose sharply. On average basis these prices rose about 40 percent by 1981 and over 50 percent by 1984[2]. Farmers were also able to sell a growing share of their output on the free market in urban and rural areas where price trends were even more favourable than their deliveries to the state. In the mean time, the prices paid by farmers for both manufactured consumer goods and agricultural inputs such as fuel, fertilizer, and machinery were relatively stable.

The burst of agricultural output growth, however, was short lived. Since 1984 the rate of growth of agricultural output has fallen to almost half of the rate achieved in the

---

[1]China Statistics Bureau, China Statistical Yearbook, 1991 (Beijing: China Statistics Publishing House).

[2]Ibid., 624.

first six years of the reform[3].There were numerous reasons for the slowdown in agricultural growth. The major reasons appeared to be insecurity of farmland ownership, difficulty in marketing surpluses, and increased costs in agricultural inputs. While many farmers have greatly benefited from reduction in controls, the end of state monopoly in wheat has let them exposed, as they have not been in the past, to the vagaries of the market. This is a political, as well as an economic risk, and suspicion can not be entirely put aside that, at the first sign of trouble, current policies might equally be put into reverse. The surpluses generated up to 1984, which could not all be used to supply the urban areas because of the inadequacies of transportation facilities, caused farmers' returns to fall. Some farmers turned away from cereals to more profitable cash crops. In addition to the decline in use of fertilizer and irrigation works by the farmer in order to keep input low, wheat production fell in 1985, the first time since 1980,

Pricing continues to be a major problem in the monopoly supply system. Prices of agricultural inputs, largely manufactured in urban areas, have been allowed to rise since as labour and material cost increase. For example, the price of chemical fertilizer, plastic sheeting, and pesticides rose 18.9 percent in 1989. Government purchase prices for farm products, however, have risen more slowly because the policy has kept urban retail prices for grain stable. If the government increases its grain purchase price, it must allocate more funds from tax revenues to subsidize retail prices. Given budget limitations and its policy of favouring urban consumers, the government has restricted further

---

[3]Lardy, N.R., "Foreign Trade and Economic Reform in China, 1978-1990", (USDA, ERS, Washington DC), 21.

increase in farm procurement price increases.

Although the down turn in no way caused supply difficulties, the authorities, with more than one billion people to be fed and kept content, could not ignore the danger of a loss of impetus in production, and acted quickly. Farmers who had turned away from cereals to produce more profitable cash crops such as peanuts, are being urged to go back to grains. More fertilizer supplies are being made available at reduced prices. Basic procurement prices will for the time being remain unchanged, although farmers in certain areas are being given more incentives. The determination of Chinese authorities to keep wheat production moving upwards will doubtless meet with some success. Under the current target for grain production, China's grain output is expected to grow at 5.4 million tons a year. Although the government intends to increase investment in agriculture, such an increase will be hard to achieve. In a sense, the easy gains have already been made. Most of the crops are well irrigated and fertilized, and farmers have been given the monetary incentive to maximize their output. After land diverted to other crops has been returned to wheat production, a fundamental way in which output can be kept increasing in coming years would appear to be through varietal improvements. China's researchers are experimenting by crossing local strains with the best North American and European types in order, especially, to improve scab resistance. This will be a major breakthrough, eliminating an important cause of low quality in domestic wheat.

For a long period of time, "China is heavily subsidizing grain consumption by about 200 million urban residents, at a cost to the government of over 29 billion Yuan (nearly US$ 8 billion at the official exchange rate) per year. The grain consumption

subsidy is now consuming 11 percent of all government revenue"[4]. This subsidization policy is implemented through a fixed-price grain supply system for basic human consumption, it causes excessive demand. To reduce the increasing budget pressure over the past decade, the Chinese government tryed to introduce a dual price system in urban food supply. However, the government was caught between food control and subsidy. After a ten-year long stagnant experiment, China's government eventually lifted the grain rationing and dual price system for urban grain supply in 1992.

2.1 China's Wheat Import History

China's wheat imports started in the early 1960s and have been influenced by a number of factors including policy changes and domestic agricultural performance. From Table 1.3 in Chapter 1, it is easy to understand the major role of wheat imports in China's wheat supply - supplement to total wheat production to meet excess demand.

China was a net grain exporter until starting to import wheat in 1961 when it experienced successive years of agricultural failures. To stabilize the domestic situation and political turmoil, the Chinese government decided to seek wheat import sources from western countries although it was facing economic embargo from the western world due to ideological confrontation. "In 1960, facing a critical food shortage due to policy failures of the Great Leap Forward and successive years of crop disaster, the Chinese approached Canadian Trade Commissioner John Small in Hongkong. Their purpose was

---

[4]Goldberg, J.R., "Grain options for China - 1990-2000", In Agricultural reform and development in China, (Beltsville, MD:Ideals, 1990).

to negotiate a cash sale, and secure credit for future purchases of Canadian grain. Since the Export Development Corporation could not extend credit to a country which Canada did not recognize, the government was forced to make a political decision. Cabinet guaranteed the Wheat Board's borrowing from chartered Canadian banks, as a result the Canadian Wheat Board extended credit to China"[5].

This historical business relation established a solid foundation for the subsequent wheat trade between the two counties over the past three decades. After this initial assistance, Canada's share in China's wheat imports has been an important concern to the Chinese government for not only economic but also political reasons. For example, Canada's share increased to 100 percent in 1971 when the two countries exchanged ambassadors. However, after the Sino-US diplomatic relation was established in 1975, the United States gradually gained a larger share of the wheat trade that Canada had previously enjoyed.

Between 1960 and 1980, average annual Chinese imports amounted to approximately 4.5 million tons. In 1980, China became one of the major player in the world wheat market by importing 13.8 million tons of wheat, and it repeated that performance for two consecutive years. In 1983, parallel to an increase in wheat production from 68.4 million tons in 1981 to 81.4 million tons in 1983, Chinese imports dropped to 9.6 million tons. Production kept rising, and China imported only 6.6 million tons in 1985. But the increase in production was unable to keep pace with the increase

---

[5]Minden, K., "The Politics of Cerealism: the Wheat Trade and Canadian-Chinese Relations" (working paper #27, The Joint Centre on Modern East Asia - University of Toronto - York University), 4-5.

in consumption. China had to increase import quantities of wheat to 15.8 million tons in 1992.

Considering the quantity of imported wheat in China, it has not been a large percentage compared to China's total grain output. This does not imply that wheat imports are not important to China's grain supply. Actually the following two points are important to note:

1. The imported wheat only goes to the coastal area in the south and the east, and industrial cities in the northeast, therefore, the imported wheat accounts for a high percentage in local food grain supply.

2. Wheat was considered fine grain in the food grain supply for urban residents. It is logical to only compare the imported wheat with local wheat supply.

As a matter of fact, imported wheat has played an important role in China's urban food grain supply for reducing the pressure on the Chinese agricultural production over the last decade.

2.2 China's Grain Trading System

China has a completely state controlled trading system although some market forces have been incorporated into the trade economy during the last decade. The government uses trade to achieve both economic and political objectives. In practice, the Ministry of Foreign Trade and Economic Cooperation makes annual and medium-term foreign trade plans under the guidance of the State Planning Commission. The plans are implemented by state-owned trading corporations and their subordinated foreign trade

bureaus at provincial government levels.

The main objective of China's foreign trade is to import advanced technology and equipment. The volume of such imports is heavily dependent upon exports. China makes great efforts to export agricultural commodities, raw materials, and light industry products to earn as much hard currency as possible. In the meantime, the country limits unnecessary imports by imposing quotas or planned targets to save foreign currency. China's agricultural trade in the past decade has been closely guided by policies and programmes to achieve this objective.

The aim of China's grain trade with foreign countries is to balance domestic demand and supply for certain basic commodities. The typical examples would be rice exports and wheat imports. During the late 1970's and the early 1980s, the government allowed more grains, particularly wheat, to be imported to urban areas so farmers could retain more grains for their own consumption. While China managed to sharply increase grain output in the mid-1980s, the government ordered a drastic cut in grain imports and vigorously expanded grain exports, mostly corn, from the northeast China. In the late 1980s, the government started importing more grains because of stagnant domestic production and increased domestic demand.

In agricultural trade, the state-owned China National Cereals, Oils and Foodstuffs Import and Export Corporation, China National Native Produce and Animal Byproducts Import and Export Corporation and China National Textile Import and Export Corporation handle most of the basic agricultural commodity imports and exports.

Since 1987, the government has promoted exports through contracts signed by

national, provincial and local trade corporations. The government classifies agricultural commodities for export into three groups. Those in the first group, such as rice, wheat, soybeans, and cotton, may be exported only by designated central trading corporations, because they are closely related to people's daily life. The commodities in the second group such as animal fur can be exported only by designated provincial or local trading corporations because of limited international markets. The last group includes all remaining commodities which can be exported by any local trading corporations. There are also three groups of agricultural imports. The first group, such as wheat and corn, may be imported only by central trading corporations. Wool and wood pulp included in the second group can be handled jointly by national and local trading corporations. The third category of all other items may be imported by any local trading corporations.

China's agricultural trade performance over the 1980s experienced a pattern change. During the 1980s, China joined the U.S., the European Economic Community, and the former Soviet Union as a dominant force in the international grain economy. By the end of the 1980s, China had become responsible for more than one-third of the world's rice production and utilization, about 20 percent of its wheat, about 15 percent of its corn, and as a producer--more than 10 percent of the world's soybeans. China's share of world total rice exports had declined from over 20 percent in 1975 to only 2.6 percent in 1989. China's wheat exports have been negligible, but the total imports increased from only 5.4 percent of world exports in 1975 to over 15 percent by the end

of 1991/1992 crop year[6].

[6]World Bank, China: Options for Reform in the Grain Sector, (Washington DC, 1991), 113.

CHAPTER 3

CONCEPTUAL FRAMEWORK

3.0 Theoretical Framework

One of the most difficult component in estimating trade demand of centrally planned economies is to model often unknown decision-making process. Many research findings are undermined due to a lack of understanding of the decision-making processes and the resulting impact on actual purchases. Ideal theories are often challenged by availability of empirical data and weak assumptions on China's trade policies. As a result, It has been realized that it is not the economic theory but methodological and conceptual frameworks that largely rule empirical studies of China's wheat imports.

The import demand for wheat is not a derived demand, but rather a direct demand determined by a number of factors. In this section, the characteristics of China's wheat trade, consumption patterns, demand and supply of total grains and wheat, and the government intervention in wheat supply will be discussed in order to define important variables for the development of a conceptual framework, to determine methods of analysis, and to make sound assumptions and hypotheses for the application of western economic theory to a centrally planned economy.

3.0.0 Demand and Supply of Grain and Wheat

Wheat imports in China only account for a fraction of the nation's total grain consumption. Therefore, the wheat trade is closely related to the total grain supply and demand conditions. In the scenario of China's consumption situation, maximization of food grain supply has been accomplished through the importation of wheat to reach grain demand and supply equilibrium.

According to consumption theory, maximization of an individual's utility is subject to the person's income and tastes. Consumption tends to be high with high income and low when income is limited if the good is a normal good. In the case of food grain consumption, a specific food item can change its category from a normal good to a inferior good for a person as the person's income increases, and at the same time expenditure share on food declines, and vice versa. Wheat was traditionally considered a superior food grain in China before the 1980s, especially in northern China during the heavy rationing period of the 1970s. As income in China has increased at a fast pace over the past decade, wheat has become widely available in private markets in most regions of China. The marked consumer preference for wheat has evolved at the expense of other grains except rice--its share has remained about constant because rice consumption share has dramatically increased in northern China while its share in the south does not tend to decline significantly. The macro-level statistics are often offset interregionally.

This significant change made Chinese consumers' behaviour patterns explainable with Engel theory. Table 3.1 and Table 3.2 below reflect some basic changes in Chinese consumers' diet and food expenditure during the late 1980s.

Table 3.1 Food Consumption per Family Based on Income , 1990[1]

Unit (kg)	Gross Income per family (Yuan)					
	<2000	2000-2500	2500-3000	3000-3500	3500-4000	>4000
Foodgrain	145.77	138.06	134.47	133.06	134.89	132.59
Pork	16.17	15.15	14.65	16.18	17.15	17.85
Beef,lamb	2.67	3.08	3.47	3.34	3.67	3.79
Egg	5.09	5.13	5.28	5.64	6.31	7.00
Fish	4.49	4.23	5.02	5.55	5.77	6.49

Table 3.1 shows that grain consumption tends to decline as the family's income rises while all other high protein food items such as beef, pork, eggs etc. increase. This implication strongly suggests that food grain, basically wheat flour and rice, account for a decreasing portion of the Chinese diet as income increases. The figures in Table 3.1 show that the average consumption of food grain was 145.77 kg for a Chinese family with income less than 2,000 Yuan and 132.59 kg for a family with income more than 4,000 Yuan in 1990. This is simply because families with higher income consumed more high protein foodstuffs such as various kinds of meat.

[1]China Statistics Bureau, China Statistical Yearbook 1991, (Beijing: China Statistics Publishing House), 289.

Table 3.2 Percentage of Income Expenditure on Food, 1985-1990[2]

Food item	1985	1986	1987	1988	1989	1990
grain	8.95	8.11	7.57	6.85	6.76	6.61
other good	30.14	30.35	30.30	31.36	33.55	32.94
vegetables & liquor	5.31	5.57	5.73	5.29	5.66	5.95
other	7.84	8.40	8.87	7.86	8.53	8.75
Total	52.25	52.43	53.47	51.36	54.50	54.24

It is clearly shown in Table 3.1. and Table 3.2. that both absolute terms of grain consumption and expenditure share tend to decline as income increases which is consistent with Engel theory. Table 3.2 shows the income expenditure share on food in China was 8.95 percent of total income in 1985 and 6.61 percent in 1990. But the total expenditure share on all food items was increased from 52.25 percent in 1985 to 54.24 percent in 1990 due mainly to the inflation and higher consumption of more expensive meat. This consumption trend has impact on feed grain demand. The increase of consumption of meat has also shifted food grain and feed grain shares in the total grain consumption, which is shown below in Table 3.3.

[2]Ibid., 273.

Table 3.3. Relative Share (%) of Food and Feed Grain, 1970-1988[3]

Year	Food grain	Feed grain	Seed grain	Total
1970	81	12	7	100
1980	80	15	5	100
1984	77	19	4	100
1985	74	22	4	100
1988	70	26	4	100

As a result of this share shifting, increasing demand for feed grain will create more demand for wheat in rural area as farmers have to give up their consumption of coarse grain to feed livestock on one hand, income effect for fine grain exists on the other hand. In the last decade rural consumption patterns have also changed great deal from coarse grain oriented-consumption to fine grain oriented-consumption.

Table 1.4 in Chapter I shows the continuous shortage of wheat supply in China over the last decade although the same period was the most rapid developing span in Chinese agricultural history since 1949. The wheat demand and supply conditions in China can be modelled as follows:

Wheat Demand = Human Consumption + Feed + Seeds

Wheat Supply = Wheat Production + Net Imports + Stock

But the demand is always greater than the supply (see Table 1.4). To control the excess demand, the imports and rationing system were taken and not lifted until 1992. Under the rationing system, a temporary equilibrium can be reached in the Chinese wheat

[3]World Bank, China: Options for Reform in the Grain Sector, (Washington DC, 1991), 103.

market. Therefore, it is feasible to state that the demand and supply of wheat under rationing system in China are at an equilibrium position:

Demand for wheat = Supply of Wheat

The basic demand and supply situation can be generally introduced with Figure 3.1. In figure 3.1, demand and supply are represented by D and S respectively while P_m and Q_e are equilibrium price and quantity under flexible price system. Q_aQ_b is the shortage of food grain under government rationing price P_r; The government objective is to minimize the shortage of Q_aQ_b. Q_aQ_a' is the actual shift of supply through imports. On the basis of rationing supply, the government also supplies food grain with negotiated premium price (Pp) and farmers supply the remainder at market free prices (Pm). These three portions are integrated to provide total grain supply in China.

According to demand and supply theory, the grain supply curve does not shift rightward to reduce excess demand towards the equilibrium under the government controlled prices. Food grain is price inelastic while supply is price elastic. The feasible measure to minimize the shortage of food grain is to shift the supply towards the equilibrium through imports.

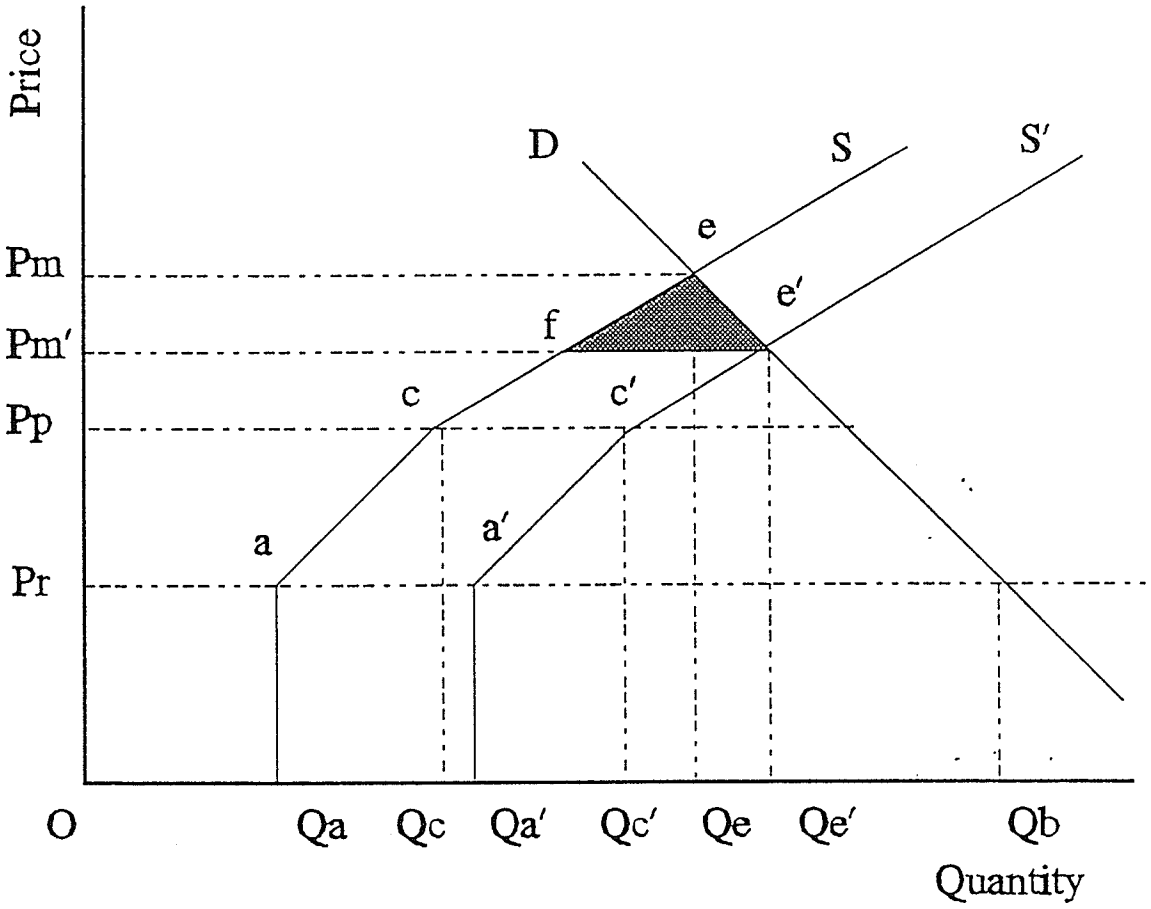

Figure 3.1 China's Grain Demand and Supply

Imports of wheat shift the supply curve rightward from S to S' and it can be measured by Q_aQ_a'. The equilibrium point moves to e' from e and the new equilibrium price is P_m' instead of P_m. The whole area of efe' is the consumer surplus created by imports. With the additional supply from imports, the actual consumer demand is met and supply of grain is increased to larger quantity of Q_e'.

3.0.1 Policy Consideration

Many wheat transactions on world wheat markets are done based on some political decisions as importing and exporting countries often subsidize their agriculture and regulate their agricultural trade. As the World Bank's study stated, world trade volumes could expand considerably if China unilaterally liberalized its policies. The expansion of China's exports could be especially large in the rice and pork trade. In corn, China switches from a net exporter to a net importer, expanding net imports of corn to feed its rapidly expanding pork industry. Global trade in wheat remains virtually unchanged[4].

Chinese foreign policy was tightly integrated with its foreign trade policy during this reform period. The inter-service between these two policies has been Chinese government's traditional strategy to seek its international position. The large imports cut on wheat from the U.S. in the early 1980s and dramatic corn exports to the South Korea are very typical examples of this policy integration. The cut on wheat imports was mainly a retaliation on the U.S. quota (considered unfair by the Chinese government) imposed on Chinese textile exports to the U.S. while a rapid expansion of corn export market in

---

[4]Ibid.

the South Korea as well as temptation of investments from the South Korea led China to the diplomatic recognition of this country.

3.0.2 Conceptual Framework

The imports of wheat by China are mostly due to the shortage of food grains, which implies that the grain production is the most important reason of this wheat trade. " The production of wheat and coarse grains for countries such as China, ... were estimated by using past trends. While this method is unsatisfactory in many respects, it is the best method available to the researchers. Countries like China cause real problems when using trends, because much of the past increase in production was due to policy changes"[5]. To tackle this problem of trend inconsistency, understanding Chinese wheat import decision-making process is a critical and fundamental part of any research related to China's wheat imports. Insufficient knowledge on this part would possibly exclude important variables or neglect lagged policy impact. Import decisions are usually made among Ministry of Internal Trade (responsible for grain distribution and marketing), Ministry of Agriculture, Ministry of Communications, Ministry of Foreign Trade and Economic Cooperation, State Planning Commission, and China National Cereals, Oils & Foodstuffs Import & Export Corporation (CEROILFOOD) under the guidance of the State Council in the early months of each calender year.

The wheat imports have to be considered on the basis of domestic grain production and consumption pattern not only trade behaviour. Domestic production output is the most

---

[5]Furtan *et al*, Grain Market Outlook, (Economic Council of Canada, 1989).

basic reference of wheat import decision-making. In accordance with annual and long-run plans drafted by the State Planning Commission and approved by the State Council, planned domestic grain trade is managed by the GGB (government grain bureaus) and its network of local grain bureaus, and planned international grain trade is carried by CEROILFOOD. The GGB and CEROILFOOD directly manage the procurement, processing, storage and sales of grain, and arrange for the domestic and international transport of grain through agencies and corporations of the Ministry of Railways and the Ministry of Communications (mostly domestic and international shipping) as well as local government departments[6].

The major references at such decision-making process would be consumption demand estimated by the Ministry of Internal Trade, including demand of feed grains, domestic supply forecasted by the Ministry of Agriculture, provincial or regional demand and supply, mainly supply, would be considered as well to maximize interregional grain marketing rate. China's grain shortage seems to be settled by these imports subject to China's foreign exchange availability and transport capacities. Sources of imports are usually the U.S., Canada, Australia, Argentina and EEC. If there is no big political deal behind, international spot prices would be followed. CEROILFOOD does not hedge at international market, the only choice is to pick up the best spot prices within the time domain of target imports.

---

[6]World Bank, China: Options for Reform in the Grain Sector, (Washington DC, 1991), 137.

3.1 Specification of Important Variables

This empirical study is to make a quantitative analysis with econometric models to derive some satisfactory interpretation and explanation of the real driving factors of import demand for wheat based on analysis of other factorial influences. To quantitatively model conceptual framework, some important variables are specified as follows:

CONST = Constant;

DV = Dummy variable for policy impact (1, 0, -1);

EXCH = Exchange rate (Chinese Yuan : US Dollar);

FB = China's total foreign trade balance, million US dollars;

GP = Amount of grain available per capita in China (TG/POP), metric ton per capita;

NGP = Net grain availability per capita (net grain import + TG) / POP, metric ton per capita;

POP = China's total population, million;

RAIP = Total agricultural investment per hectare, Yuan;

RFLR = Fertilizer applied per hectare, kilogram;

RND = Percentage of natural disaster affected area(natural disaster area/total sawn area);

RWPR = World rice price and wheat price ratio (WRP/WWP);

RY = Real income per capita, Yuan per year;

TG = China's total annual grain output, million metric tons;

TNC = Grain transportation capacity, number of railcars allocated for grain transportation;

TW = China's total annual wheat output, million metric tons;

TWM = Total wheat imports, million metric tons;

WRP = world rice price, US dollar per metric ton;

WWP = world wheat price, US dollar per metric tons;

As a result, China's wheat import demand can be summarized as a function of consumption and production output, international wheat price and rice price or corn price, China's foreign exchange balance, policy impact, and transport and handling capacities, which can be defined as the function below:

TWM = f(FB, RY, EXCH, TG, TW, POP, DV, TNC, WWP, WRP).

3.2 Methods of Analysis

In most of the similar studies, linear and log functional forms are often used and recommended for its simplicity and desirable regression results in particular. For the purpose of forecasting, long-run models are usually necessary components in the similar studies. Once functional forms are determined, correct inclusion of variables in each model becomes critical. As China's wheat import demand is a complex operation, there are many factors to be considered. To examine each variable's influence and significance in different wheat demand models under different scenarios, eight different linear and non-linear econometric models were proposed in this study after some preliminary runs.

1. Short-run models:

a. Linear form:

$$TMW = Const + \beta_1 FB + \beta_2 RY + \beta_3 EXCH + \beta_4 DV + \beta_5 GP + \beta_6 TNC + \beta_7 TW + e \quad (3.1)$$

$$TMW = Const + \beta_1 FB + \beta_2 RY + \beta_3 EXCH + \beta_4 DV + \beta_5 NGP + \beta_6 TNC + \beta_7 RND + e \quad (3.2)$$

Both equation (3.1) and (3.2) contain foreign trade balance (FB), real income per capita (RY), dummy variable (DV), foreign exchange rate (EXCH), and grain transportation capacity (TNC). The difference of these two models is that equation (3.1), in addition to above five variables, was added in with China's total wheat production (TW) and grain availability per capita (GP) while equation (3.2) was added in with net grain availability per capita (NGP) and percentage of natural disaster affected area (RND).

By dropping RND from equation (3.2) and TW from equation (3.1), the following two equations were derived:

$$TMW = Const + \beta_1 FB + \beta_2 RY + \beta_3 EXCH + \beta_4 DV + \beta_5 NGP + \beta_6 TNC + e \quad (3.3)$$

$$TMW = Const + \beta_1 FB + \beta_2 RY + \beta_3 EXCH + \beta_4 DV + \beta_5 GP + \beta_6 TNC + e \quad (3.4)$$

b. Semi-log form (Log-Linear form):

To examine the significance and influences of rice and wheat price ratio, the following two semi-log forms were proposed:

$$LOG(TMW) = Const + \beta_1 FB + \beta_2 EXCH + \beta_3 DV + \beta_4 TNC + \beta_5 RWPR + e \quad (3.5)$$

$$LOG(TMW) = Const + \beta_1 FB + \beta_2 EXCH + \beta_3 DV + \beta_4 TNC + \beta_5 RWPR + \beta_6 GP + \beta_7 RY + e \quad (3.6)$$

Both these two models include foreign trade balance (FB), foreign exchange rate

(EXCH), dummy variable (DV), grain trasportation capacities (TNC), and world rice and wheat price ratio (RWPR). In addition, equation (3.6) includes grain availability per capita (GP) and real income per capita (RY).

2. Long-run models:

One of the objective of this study is to develop a long-run forecasting model for China's wheat import demand. Regarding forecasting models, long-run concepts should be considered. All the simple linear and semi-log models discussed in this section are short-run models and specified directly with consumption theory. The distributed lag models are often employed in long-run demand forecasting studies. The Koyck model was chosen for long-run forecasting objective in this study and the derivation of this model was discussed below.

Theoretically, the Koyck model is derived through an expectation model. In this study it can be described as follows:

$$TWM_t^* = c + X_t\beta + e_t \qquad (3.7)$$

TWM_t^* is expected level of wheat imports for current year, X_t represents a set of explanatory variables for current year. Such a formation of expectations is based on the idea that the TWM_t^* is the most desirable quantity of imports if everything else is possible. TWM_t^* is not directly observable, but it is possible to assume that an attempt is being made to bring the actual level TWM to its desired level, and that such an attempt is only partially successful during any one period. The reasons why a complete adjustment of TWM to TWM^* is not achieved in a single period may be varied from

institutional rigidities to constraints of physical facilities. TWM_t^* was defined in two equations in China's wheat import demand scenario as follows:

$$TWM_t^* = Const + \beta_1 FB_t + \beta_2 RY_t + \beta_3 DV_t + \beta_4 EXCH_t + \beta_5 TG_t + \beta_6 TNC_t + e_t \quad (3.8)$$

$$TWM_t^* = Const + \beta_1 FB_t + \beta_2 DV_t + \beta_3 EXCH_t + \beta_4 GP_t + \beta_5 TNC_t + e_t \quad (3.9)$$

where Const is a constant, FB is foreign trade balance, RY is real income per capita, DV is policy dummy variable, EXCH is China's foreign exchange rate, TG is China's total grain output, GP is amount grain available per capita, TNC is China's grain transportaion capacity, and e is a random residual.

The relationship between the actual and desired level of TWM can be specified as follows:

$$TWM_t - TWM_{t-1} = \gamma(TWM_t^* - TWM_{t-1})$$

$$\text{or } TWM_t = \gamma TWM_t^* + (1-\gamma)TWM_{t-1} \quad (3.10)$$

where TWM_t is the actual level in the current period, and $0 \leq \gamma \leq 1$ is called "adjustment coefficient" since it indicates the rate of adjustment of TWM to TWM^*. When $\gamma = 0$, there is no adjustment and TWM_t is equal to the previous period TWM_{t-1}; when $\gamma = 1$, there is an instantaneous adjustment and $TWM_t = TWM_t^*$.

Substitute equations (3.8) and (3.9) into equation (3.10) respectively, and then TWM_t can finally be expressed in the following equations:

$$TWM_t = \gamma(Const + \beta_1 FB_t + \beta_2 RY_t + \beta_3 DV_t + \beta_4 EXCH_t + \beta_5 TG_t + \beta_6 TNC_t) + (1-\gamma)TWM_{t-1} + U_t \quad (3.11)$$

$$TWM_t = \gamma(Const + \beta_1 FB_t + \beta_2 DV_t + \beta_3 EXCH_t + \beta_4 GP_t + \beta_5 GP_t + \beta_6 TNC_t) + (1-\gamma)TWM_{t-1} + U_t \quad (3.12)$$

The coefficients $\gamma\beta_i$ and $(1-\gamma)$ are derived directly as regression coefficints[7]from these two estimable equations. The estimation of coefficients can be done in a numerous ways, however, autocorrelation will likely occur considering the time series data to be used in this study. According to the recommendations of most econometrcians, maximum likelihood technique in estimating coefficients of distributed lag models is superior to other applicable methods. Therefore, maximum likelihood was chosen for Koyck models including in estimating coefficients of all other models in this study.

3.3 Assumptions and Hypothesis

Due to characteristics of China's partial centrally planned economy and insufficient statistic data set, it is necessary to set some acceptable assumptions to strengthen theoretical foundations of this study.

1. Assume that there is always an excess demand of grain and wheat because China had a grain rationing system to control the demand for grain during the studied period.

2. Assume that China's current agricultural pricing system is consistent through

---

[7]Yeh, M.H., "Demand Functions for Fertilizer in Canada", Canadian Journal of Agricultural Economics, Vol. VIII, No.2, 1960, 55.

out 1990's.

3. Assume that China's political situation keeps on the same track for the length of projection time. Any great political reversal is not assumed, so are the economic reforms.

4. Assume that there is no new variety of wheat that can increase yields significantly within the projection period as licensing of new variety takes long time.

5. Assume that foreign exchange would be available for purchasing wheat in the projection period.

Economic theories and China's real important performance as well as previous research information have provided foundations for hypothesis in this empirical study. FB, RY, TNC, RWPR, RND and DV are supposed to have positive sign while GP, TW, EXCH have negative sign.

3.4 Data

Time-series data covering 1961-1990 taken from various publications were used for this study. China Statistical Yearbook, 1991; World Wheat Statistics, 1990; World Rice Statistics Yearbook, 1990; International Financial Statistics, 1990; USDA reports. Efforts were made to maximize the use of Chinese statistics if data from different sources are inconsistent. Facts have shown that grain output figures estimated by non-Chinese origin are consistently lower than the actual figures in the officially released Chinese data set. As other researchers encountered before, some data from different sources were collected either on calendar year or crop year basis. This study completely excluded this

data deficiency to improve data quality.

Million tons were used for quantity, US dollar was used for monetary value, million was used for population. Yuan was used to convert Chinese currency to US dollars. U.S. Fob export price ex Pacific west coastal port was used as proxy of China's wheat import price as the real contracted prices were not available. Fob Bangkok rice prices were used as proxy of rice export price.

All data are presented in Tables in the Appendix.

CHAPTER 4

EVALUATION AND INTERPRETATION OF THE EMPIRICAL RESULTS

4.0 Evaluation of Short-run Model Results

Desirable regression results are not only the primary objectives of an empirical study but also the foundations of forecasting future patterns. The regression results of this study fell within the statistically and econometrically significant ranges and further provided evidence for previously discussed conceptual frameworks and assumptions. The evaluations on short-run and long-run models in this study were discussed separately in the following two sections. The discussions of individual variables were followed after the evaluations of short-run and long-run models. All the regression results of the short-run and long-run models are presented in Tables 4.1, 4.2 and 4.3.

Table 4.1 Results of Linear Regressions

Var.[a]	Eq.4.1[a]	Elas[a].	Eq.4.2	Elas.	Eq.4.3	Elas.	Eq.4.4	Elas.
Cons.	19152 (2.87)[b]	2.0547	17596 (2.44)	2.3798	15000 (2.723)	2.0287	16782 (3.284)	2.269
FB	0.3566 (5.66)	0.057	0.3684 (5.283)	0.059	0.3669 (5.284)	0.054	0.3666 (5.837)	0.06
RY	20.756 (3.53)	1.3629	18.063 (3.126)	1.1860	17.07 (3.22)	1.1208	18.315 (3.644)	1.203
EXCH	-62.75 (-6.44)	-2.092	-65.85 (-6.05)	-2.195	-65.79 (-6.11)	-2.192	-64.39 (-6.47)	-2.15
DV	949.3 (2.90)	0.004	1164.6 (4.248)	0.005	1172.9 (4.309)	0.005	1118.4 (4.241)	0.005
GP	-2816 (-1.40)	-1.184					-3983 (-2.61)	-1.675
NGP			-3925 (1.96)	-1.681	-3228 (-2.01)	-1.382		
TNC	6.2821 (3.305)	1.3383	7.2187 (3.889)	1.5379	7.3141 (3.962)	1.5582	6.8693 (3.823)	1.464
TW	-0.055 (-0.90)	-0.376						
RND			1574.4 (0.566)	0.10				
R^2	0.9217		0.9142		0.9137		0.9200	
DW	1.8436		1.7780		1.7285		1.7330	

[a]Note: Var.=Variable, Eq.=Equation, Elas.=Elasticity.
[b] All t's of regression coefficients are in parenthesis.

The regressions of the two log-linear form models are presented in Table 4.2.

Table 4.2 Results of Log-Linear Regressions

Variable	Equation 4.5	Elasticity	Equation 4.6	Elasticity
Const.	7.2372 (21.532)[a]	7.2372	8.3670 (9.3477)	8.3670
FB	0.00003 (3.0564)	0.0338	0.00004 (3.3862)	0.0417
RY			0.0013 (1.7570)	0.6403
EXCH	-0.0042 (-4.0647)	-1.0472	-0.6596 (-4.4553)	-1.6259
DV	0.2937 (5.8932)	0.0098	0.2747 (6.1649)	0.0092
GP			-0.2259 (-0.8731)	-0.7024
RWPR	0.1957 (2.0876)	0.4512	0.2021 (2.1695)	0.4660
TNC	0.0014 (7.9040)	2.1869	0.0011 (3.6209)	1.7126
R^2	0.8844		0.8917	
DW	1.8009		1.9589	

[a]All t's of regression coefficients are presented in parenthesis.

All short-run regression equations except two log-linear equations have statistically significant R^2 at the 1 percent level, which indicates that more than 99 percent of the dependent variable's change was explained by the specified variables in these equations. The regression results are consistent with some other previous studies in verifying functional forms appropriate to this particular demand behaviour. The log-linear functional form was not as desirable as the linear form although log-linear functional form also

obtained significant estimates in this study. It is possible that some other functional forms could also have explanatory power in modelling China's wheat imports. However, linear form is the most desirable one based on available economic information, statistical data, and numerous preliminary runs conducted in this study.

This study used time-series data covering a period of 1960 to 1990. It is commonly believed that time-series data cause autocorrelation problems such as inefficient estimates and larger variance although estimates may not necessarily be biased estimates. Usually some econometric cures can be implemented to correct the autocorrelation problem after defining the order of the autocorrelation. This study obtained satisfactory estimates in most of regression equations with ordinary least square method but Durbin-Watson statistics were low in each equation, which suggested some autocorrelation existed in each equation to a certain degree. To tackle this problem, either generalized least square or maximum likelihood method can be considered as an efficient technique. Maximum likelihood method was used in the study due to the assumption of first order autocorrelation and some computer programming convenience. Due to the application of maximum likelihood technique in the regression of all equations, Durbin-Watson statistics for each equation were improved to be significant at the 1 percent level.

Equation (4.4) is the best short-run model among these six equations. Absence of a lagged dependent variable in equation (4.4) may not make it as an ideal long-run forecasting model, but an appropriate short-run forecasting model.

4.1 Evaluation of Long-run Model Results

Table 4.3 presents the regression results of the distributed -lag models which were defined as long-run models in this study. The interpretation of the results were followed in the subsequent section 4.2.

Table 4.3 Results of Distributed Lag Models

Variable	Equation (4.7)	Elasticity	Equation (4.8)	Elasticity
CONST	7312.9 (3.2474)	0.9890	8226.6 (4.6816)	1.1126
Lagged TWM	0.3788 (6.2876)	0.3574	0.4489 (5.8483)	0.4236
FB	0.3461 (7.4832)	0.0550	0.2967 (5.6281)	0.0472
RY	10.069 (3.0383)	0.6612		
DV	1086 (4.3063)	0.0049	1337.7 (4.8501)	0.0060
EXCH	-40.409 (-8.6950)	-1.3470	-29.11 (-7.4660)	-0.9704
GP			-4714.5 (-5.8700)	-1.9826
TG	-0.0511 (-6.0399)	-2.0030		
TNC	11.283 (8.9440)	2.4038	11.599 (9.9431)	2.4711
R^2	0.9548		0.9422	
DW	2.0339		1.9725	

Both equations (4.7) and (4.8) have high R^2, appropriate Durbin-Watson statistics, and efficient estimates which make them desirable equations for forecasting.

Equation (4.7) is the most appropriate model for forecasting overall compared to all other equations although population is not included in equation (4.7). As mentioned above, interchangeable use of grain availability per capita and total grain output in the import decision-making process, the absence of population in equation (4.7) does not necessarily reduce the forecasting power of equation (4.7) as long as the assumption of policy patterns holds true within the predicted period. The predicted period in this study is up to the year 2000 or a ten-year period which is considered a medium to long-run forecasting domain. Therefore, equation (4.7) was applied for forecasting in this study.

4.2 Interpretation of the results

The results of each regression equation and involved variables were discussed separately in this section to examine the difference between equations by adding or dropping each additional variable. As the model evaluation in section 4.1 shows the most desirable short-run model and long-run models are equation 4.4 and 4.7 respectively, the elasticities of variables in these two recommemded models by this study will also be interpreted in this section.

It is clear that all models have high R^2 but not every variable in the equations has significant t-ratio at the 5 percent significance level. With the regression coefficients, equation (4.1) becomes the following one:

$$TWM = 19152 + 0.3566FB + 20.756RY - 62.747EXCH + 949.3DV - 2816GP + 6.2821TNC - 0.0546TW \quad (4.1)$$

$R^2 = 0.9217 \quad DW = 1.8436$

This equation contains 7 variables and constant, and all coefficients have correct signs. Foreign trade balance and exchange rate have highest t's, which suggests that these two variables have a larger influence on the dependent variable in the model. During the 1960s and 1970s, China was experiencing a severe shortage of foreign exchange and the domestic income per capita was very low. This result of regression reflects that China's import demand has been highly dependent upon its foreign trade situation. If foreign trade was in surplus, it's import demand for wheat was likely to increase. Domestic income per capita played the same positive role while exchange rates always exerted a negative pressure on import demand because the government had to subsidize imported wheat to urban residents to a large degree. If the exchange rate was too high, the government would be unable to carry a large bill for subsidies as Chinese urban residents enjoyed fixed rationing wheat flour prices during the course of from 1960s to the 1970s and most of the 1980s. As their income changed very little during that period, the income variable more likely reflected the government's financial capabilities in subsidizing grain imports.

The dummy variable has the correct sign and significant t-ratio as assumed. In the previous research reviewed in this study, dummy variables were not considered by any research in regression models due to the difficulty of quantifying political elements although policy impact was descriptively discussed. This study quantified the policy impact with a dummy variable and the regression results proved the significance and

importance of this factor. It is important to observe that China's political and economic policies have a significant impact on import demand. Policy impact is instantaneous and does not have long lagged impact as a result of the purchasing decision-making process: a spot factor decision.

Grain transportation capacity also has a significant t-ratio and correct sign. This reflects the influence of infra-structures at ports and railway grain transfer depots. Complaints from COSCO (China Ocean Shipping Corporation) have made grain imports a very careful business. As some grain vessels have to be fumigated at port or anchor water, unloading delays each year result in a large amount of compensation being paid to shipping companies. To avoid unnecessary compensation to foreign shipping companies, the Chinese government has been careful in determining large volume of grain imports. However, with modernization of port management, concentrated vessel arrivals and unloadings will likely be improved significantly.

Neither grain availability per capita (GP) nor total wheat production (TW) have significant t's at the 5 percent level. But they both have correct signs which are consistent with the assumptions and relevant theory.

When China's domestic grain availability and total wheat production output are high, its import demand for wheat are expected to be low. In reality, however, China's import demand has not been affected significantly by the domestic wheat output simply because China's wheat production is relatively low compared to total grain output although the wheat production reached to 22 percent of the total grain output in 1990 and

positioned China the largest wheat producer in the world[1].

Grain availability per capita is assumed to be an important variable in the model. But the result does not reflect the significance of this variable's presence. Therefore, equation (4.2) was attempted with a more accurate grain availability variable (net grain availability per capita NGP) and a ratio of natural disaster affected area and total sown area (RND) to measure the overall grain output situation.

$$TWM = 17596 + 0.3684FB + 18.063RY - 65.849EXCH + 1164.6DV - 3925NGP + 7.2187TNC + 1574.4RND \quad (4.2)$$

$R^2 = 0.9142$ DW=1.7780

The regression results indicate the two added variables are not statistically significant at the 5 percent level. The insignificance of NGP can be explained by the wheat import decision-making reference factors because Chinese decision makers usually take gross grain availability per capita or gross grain output as a measurement of grain supply and the small amount of grain export is not a determinant factor.

The insignificant natural disaster impact is highly offset by China's cropping system. Double cropping is extensively applied in major grain producing areas especially in south China and the northern plain areas, which effectively offsets one of the crop failures either first or second. It is difficult to estimate total annual grain losses caused by natural disaster due to limited information and data. The statistical data on natural disaster impact collected by the Ministry of Agriculture shows that China's total annual

---

[1]China Statistics Bureau, China Statistical Yearbook, 1991, (Beijing: China Statistics Publishing House).

natural disaster affected area averages between 250 million and 350 million Mu within the studied period without much improvement in anti-natural disaster(flood or drought and the like) capacity, which are not realistic reflections of China's heavy investments in water conservation, drainage, and flood control projects in the 1970s and of fast development of China's irrigation-farming in major grain producing areas especially in northern China.

There are also some other reasons which affect the accuracy of this data. To lobby central and/or provincial governments for natural disaster aid-funding and the following year's compensation type investments, false reporting on exaggerated disaster impact is a usual practice of local officials. Thus, it is impossible to separate the real and false statistical data of natural disaster impact on grain losses based on in-hand information although natural disaster has a definite impact on grain availability.

To improve the quality of the estimates, RND was dropped out in equation (4.3). The regression results showed no improvement on R^2 but high t-value of NGP, which made the entire equation statistically and econometrically acceptable.

$$TWM = 15000 + 0.3669FB + 17.07RY - 65.79EXCH + 1172.9DV - 3228NGP + 7.3141TNC \quad (4.3)$$

$R^2 = 0.9137 \quad DW = 1.7285$

To further improve the results, gross grain availability (GP) was used in equation (4.4) to replace net grain availability (NGP).

$$TWM = 16782 + 0.3666FB + 18.315RY - 64.39EXCH + 1118.4DV - 3983GP$$
$$6.8693TNC \qquad (4.4)$$
$$R^2 = 0.920 \quad DW = 1.7330$$

After the modification was made, both t-value of grain availability and R^2 were improved. Overall, coefficients in equation (4.4) have more desirable properties than those in other equations. As Table 4.1 indicates, Equation (4.4) produces the best results with significant estimates and high R^2 among all short-run models although some of other models have acceptable statistical estimates. Equation (4.4) contains six explanatory variables: foreign trade balance, real income, exchange rate, dummy variable, amount of grain available per capita, and transportation capacity. The coefficients of these six variables all have correct signs and statistically significant at the 1 per cent level. Four of the six variables have elastic effect on import demand. A 1 per cent increase in real income will increase import demand by 1.203 per cent while other variables remain the same. Similarly, a 1 per cent increase in exchange rate will cause 2.15 per cent decrease of import demand; a 1 per cent increase in grain availability per capita will decrease 1.675 per cent imports; a 1 per cent increase in transportation capacity will increase imports by 1.464 per cent. The exchange rate shows the highest elasticity in all models that indicates exchange rate is the most sensitive variable in the models. Real income per capita, foreign trade balance, and transportation capacity have positive impact on the wheat imports in the applied models while all other variables show negative impact.

The two log-linear functional forms also have relatively desirable econometric properties mainly attributed to the correct variable specification.

$$LOG(TWM) = 7.2372 + 0.00003FB - 0.0042EXCH + 0.2937DV + 0.1957RWPR + 0.0014TNC \quad (4.5)$$

R^2=0.8844, DW=1.8009

Some preliminary runs did not produce satisfactory results in linear forms with this variable. During the past two decades of the studied period, China's rice exports have been greatly volatile and influenced by world rice prices resulting in a reduced volume. It is not for forecasting but for empirical analysis purposes that this variable was included and examined. Although the present rice export volume is small, the large quantities of rice exports during the 1960s made it significant in the model with a significant t-value.

This significant t-ratio implies that China took comparative advantages of the world rice and wheat price ratio during the years when rice prices were high for exports which generated hard currency for wheat imports under the agricultural self-sufficiency policy.

$$LOG(TWM) = 8.367 + 0.00004FB + 0.0013RY - 0.6596EXCH + 0.2747DV - 0.2259GP + 0.2021RWPR + 0.0011TNC \quad (4.6)$$

R^2=0.8917, DW=1.9589

The results of equation (4.6) verified the insignificance of income and grain availability in the scenario of taking advantage between rice and wheat prices in the world market. It was clearly verified that Chinese government was not able to take income per capita and grain availability per capita into consideration when it needed foreign exchange

badly or it wanted to offset hard currency expenditures on wheat imports by maximizing rice exports. Real income per capita (RY) and grain availability per capita (GP) played less important roles in this situation compared to the significance of other factors. Compared to the linear forms, these two log-linear functional forms are not superior neither from statistical nor from economic points of view.

Distributed-lag models were also attempted in order to examine the impact of a lagged dependent variable.

$$TWM_t = \gamma(Const + \beta_1 FB_t + \beta_2 RY_t + \beta_3 DV_t + \beta_4 EXCH_t + \beta_5 TG_t + \beta_6 TNC_t) + (1-\gamma)TWM_{t-1} + U_t$$

$$= 7312.9 + 0.3461FB_t + 10.069RY_t + 1086DV_t - 40.409EXCH_t - 0.0511TG_t + 11.283TNC_t + 0.3788TWM_{t-1} \quad (4.7)$$

$R^2 = 0.9548$ DW = 2.0339

where $(1-\gamma) = 0.3788$, therefore $\gamma = 0.6212$ $\beta_1 = 0.5571$ $\beta_2 = 16.209$ $\beta_3 = 1777$ $\beta_4 = 65.05$ $\beta_5 = 0.0823$ $\beta_6 = 18.1632$.

$$TWM_t = \gamma(Const + \beta_1 FB_t + \beta_2 DV_t + \beta_3 EXCH_t + \beta_4 GP_t + \beta_5 TNC_t) + (1-\gamma)TWM_{t-1} + U_t$$

$$= 8226.6 + 0.2967FB_t + 1337.7DV_t - 29.11EXCH_t - 4714.5GP_t + 11.599TNC_t + 0.4489TWM_{t-1} \quad (4.8)$$

$R^2 = 0.9422$ DW = 1.9725

where $(1-\gamma) = 0.4489$, therefore $\gamma = 0.5511$ $\beta_1 = 0.5384$ $\beta_2 = 2427.37$ $\beta_3 = -52.82$ $\beta_4 = -8554.71$ $\beta_5 = 21.05$

Both equations have statistically significant R^2's and t-ratios at the 1 percent level. In equation (4.7) grain availability per capita (GP) was replaced with total grain output (TG) and real income per capita (RY) was excluded from equation (4.8) after a few preliminary runs to obtain more desirable econometric properties. Theoretically, GP would be a more accurate factor for determination of grain availability and income effect should also be considered. In practice, the Chinese government often measures grain supply situation with total grain output and sets it as the main agricultural target. Especially as China did not have a population census through the entire 1960s and 1970s, inaccurate population estimates would not be included in a short-run decision-making process. On the other hand, income per capita may be affected by multicollinearity to have an insignificant t-value. The long-run models show very desirable properties in terms of estimates and functional form.

Equation (4.7) has a R^2 value of 0.9548 and Durbin-Watson value of 2.0339. All estimated coefficients have correct signs as assumed and they are statistically significant at 1 per cent level. Lagged import demand, foreign trade balance, real income, and dummy variable have inelastic effect while exchange rate, total grain output, and transportation capacity have elastic effect. As Table 4.3 shows, 1 per cent increase of exchange rate will result in 1.347 per cent decrease in wheat imports while other variables remain the same. Similarly, 1 per cent increase in total grain output will decrease 2 per cent of wheat imports, and 1 per cent increase in transportation capacity will increase wheat imports by 2.4 per cent.

The significant coefficient of lagged dependant variable shows the impact of

previous imports on the current year's import demand. In a long-run, the previous year's imports may have effect on following year's wheat stocks that effectively influence wheat import decision-making. The adjustment coefficients of γ are 0.6212 and 0.5511 in equation (4.7) and (4.8) respectively. It indicates (in equation 4.7) that 62.12 percent of China's import demand was adjusted in one period of time in respect to changes of variables in that particular period. Demand was partially adjusted in one period of time according to these two distributed-lag equations. It is usually perceived that the huge operations of China's wheat imports involve many institutional and infra-structural limits which slow down any instantaneous adjustment in practice.

In most of the equations, exchange rate, grain supply and transportation conditions have higher elasticities which means, in other words, total wheat import demand is elastic to these variables. None of the previous studies have discovered that wheat imports are elastic to these variables.The conclusions have always been that China's import demand for wheat is inelastic to world wheat price, exchange rate, and income because the lack of important variables produced inaccurate results which did not thoroughly reflect China's import behaviours. The real reason which caused the exchange rate to be elastic was the government's food price subsidy. Depreciations of the Chinese Yuan cost huge amounts of the government's annual budget to subsidize urban residents' food expenditure before the government finally removed the rationing system in food grain supply in 1992.

The wheat import demand is also transportation capacity elastic according to all regression equations pursued by this study. As a matter of factor, transportation capacity is one of the most important variables both in domestic grain distribution and import

scenarios although it has never been mentioned in any previous research. It was observed in this study that China's import increases and domestic grain marketing increases are crucially linked to the transportation constraint as compared to the previous analyses which concentrated solely on economic factors.

4.3 Forecasting Future Import Demand

4.3.0 Forecast Explanatory Variables

One of the objectives of this study is to make a projection of China's future wheat import demand. To achieve this objective, the macroeconomic environment in China and its interaction with world trade activities should be taken into consideration. The usual practice in estimating future values of independent variables is either to use econometric technique or statistical information with certain knowledge of variables beyond the sample range. As the economic policy and objective of trade of China changed dramatically through the studied period and more changes are anticipated for future, time-series econometric technique was considered inadequate for estimation of most of the explanatory variables for the forecasting. To incorporate the present economic environment in China and its recent trade performance, average growth rate within certain periods of time seems the most practical reference for estimating values of independent variables to be used in the forecasting except total grain output.

Equation (4.7) has seven explanatory variables including one lagged dependant variable. Six of them were required to be estimated for out-of-sample values. The variables are foreign trade balance (FB), real income per capita (RY), dummy variable

(DV), exchange rate (EXCH), total grain output (TG), and transportation capacity (TNC). Based on the above discussions, total grain production output is to be estimated with an econometric estimator as grain production output can be better explained with empirical model than other policy-oriented variables, and also China has a target for grain output for the year 2000 which can be taken as a reference.

Values for Dummy variable were set subject to the knowledge of China's past behaviour and current policy in agriculture and foreign trade sectors. China's newly defined "Socialist Market Economy" policy has revealed a booming economic environment on a nation wide scale. It is very unlikely that abrupt government intervention will happen that results in cut backs in wheat trade and closing the doors to imports. China is anxious to join GATT for the purposes of more international participation on trade issues and to overcome its trade barriers in certain international markets. To comply with the requirements of GATT, China has lifted a number of import restrictions on imports and reduced import duties. Perception of this policy scenario does not necessarily encourage wheat imports, but at least negative policy towards wheat imports is not anticipated. One of the most influential factors in agricultural trade is the Five-Year Plan, which is the focus of China's centrally planned economy. The government gives relatively more attention to agriculture during the first two years of any Five-Year Plan although this policy changes during the remaining course of a Five-Year Plan period. At this point, values of the dummy variable in the Eighth Five-Year Plan were set to be 1 for 1992, 1993, and 1994 while 0 was set for the other years. The Five-Year Plan is placed into practice with a lagged period of usually one year. For this

reason, the dummy variable was set at a value of 0 for 1991 and 1996 (first year in each Five-Year Plan). The value of 1 was set for 1994 because China is likely to encourage imports in 1994 to join GATT while 0 was utilized for 1999(another fourth year in a Five-Year Plan period).

After experiencing consecutive years of trade deficit in the late 1980s, China started to establish a trade surplus in 1990, which seems to be growing at a fair pace throughout the 1990s as China's promising economy attracts large amount of investments and exports increase remarkably. Therefore, the trade balance was anticipated to be positive and calculated with a reasonable growth rate for the 1990s[2].

Real income per capita was calculated at a rate corresponding to the growth rate during the 1980s (post-reform period). The assumption of favourable economic policies assists a positive increase in income. To modify the assumption, a lower than actual growth rate (between 1991-1992) was presumed[3].

Total transportation capacity improvement was actually based on China's Five-Year Plan targets. Large investments and long construction periods for transportation facilities and infra-structures make the variable TNC relatively constrained in terms of time frame. A 6 percent annual growth rate in transportation capacity for the period 1991 to 2000 is assumed.

---

[2]Foreign trade balance is calculated at the 10 percent and 5 percent annual increase rate for the period of 1991-1995 and 1996-2000 respectively. These two rates are basically taken according to China's exports increase and economic growth rate.

[3]A 8.7 percent annual increase rate is calculated according to the overall growth during 1979-1990. Actual income growth data are taken from China Statistical Yearbook, 1991, 21.

Exchange rates may be the most volatile variable in the equation. The Chinese government tightly controls the exchange rate which makes it difficult for projecting its future values although the depreciation of Chinese Yuan is definitely clear. To reduce forecasting errors, three scenarios of exchange rate variations (low, medium and high rates of depreciation of Chinese Yuan against U.S. Dollar) are assumed for this study. While many financial analysts believe that the exchange rate between the Yuan and the U.S. Dollar is likely to reach 10:1 or an equivalent annual rate of 8 percent by the end of this century, this study takes 8 percent and 9 percent annual depreciation rates as the normal and alternative rate respectively.

A conventional Cobb-Douglas econometric model for estimating grain production output was designed. According to the data available and examination of China's past production performance, China's grain output is highly dependent upon fertilizer application and agricultural investments. Labour and mechanization levels are not significantly important factors affecting total grain output levels. Labour force is always available in rural China and mechanization improves scale of economy rather than quality of cultivation. The traditional intensive cultivation in Chinese agricultural production has a significant impact if it is incorporated with a desirable level of fertilizer application and irrigation. Therefore, the total grain output is assumed to be a function of agricultural investment input and fertilizer application level. The Cobb-Douglas model can be expressed as:

$$TG = A(RAIP)^{\alpha}*(RFLR)^{\beta}*e \qquad (4.9)$$

or in log-form:

$$\text{Log(TG)} = \text{Log(A)} + \alpha\text{Log(RAIP)} + \beta\text{Log(RFLR)} + \text{Log(e)} \qquad (4.10)$$

where TG is total grain output, RAIP is total agricultural investment input per hectare, and RFLR is fertilizer application per hectare.

The regression results estimated with Maximum Likelihood method are presented below:

$$\text{Log(TG)} = 13.422 + 0.0583\text{Log(RAIP)} + 0.2465\text{Log(RFLR)} \qquad (4.12)$$

$$(353.18)\quad (2.0564)\qquad\qquad (16.3410)$$

$R^2 = 0.9860$, DW = 1.8805

The empirical results are consistent with the above discussion of contributors to China's grain output. All estimates are statistically significant at the 1 percent level so are the R^2 and Durbin-Watson statistics. This equation is considered a good estimator of future grain output.

To estimate values for RAIP and RFLR between 1991 to 2000, the average annual growth rate method was also attempted respectively. Different annual growth rates were assumed in agricultural input for the periods of 1991 to 1995 and 1996 to 2000 as more agricultural inputs are continually added, the government will likely be more realistic in their agriculture projections in the next Five-Year Plan based upon the current policy[4].

---

[4]Agricultural investment inputs growth rates are 8 percent and 10 percent respectively for 1991 - 1995 and 1996 - 2000 based on previous data taken from China Statistical Yearbook. A 8 percent rate of fertilizer application increase is calculated based on annual

Based on the discussion above, a forecast of grain output to the year 2000 is presented below:

Table 4.4 Estimated Grain Output between 1991 and 2000 (1,000 tons)

Year	Grain output	Year	Grain output
1991	446,413	1996	502,324
1992	456,800	1997	514,525
1993	467,428	1998	527,551
1994	478,782	1999	540,906
1995	489,921	2000	554,044

The estimated grain output is 54 million tons higher than the target output set by the government in the seventh Five-Year Plan. Considering the agricultural performance in recent years, this output is fairly realistic although many researchers still doubt the target output. As long as the assumption of policy scenario holds, it can be firmly believed in this study that this estimated grain output is feasible.

To make an alternative approach available in the study, the government's target output was considered the proxy for grain output between 1991 and 2000. An assumed growth rate for grain increase was calculated based on 500 million tons of target volume

---

growth rate between 1986 and 1990.

by year 2000.

In the forecasting of future wheat import demand in this sudy, target grain output and estimated grain output incorporated with two exchange rate scenarios were used in equation (4.7) respectively as low scenario and high scenario .

4.3.1 Forecast Future Import Demand

One of the main objectives of this study was to forecast China's future demand for wheat imports with the best models taken from the above evaluation for the long-run and short-run. It was considered that forecasting wheat import demand in this study is a long-run projection, the Distributed-lag model with lagged dependent variable is more appropriate to fit into this situation. To be practical, three scenarios of forecasting were attempted respectively with incorporation of tight exchange rate (tightly government controlled) and target production as scenario (1), flexible exchange rate (market oriented) and target production output as scenario (2), and flexible exchange rate and estimated production output as scenario (3). The forecasted imports are presented below:

Table 4.5 Forecasted Wheat Demand between 1991 and 2000[5]
(million metric tons)

Year	Scenario (1)	Scenario (2)	Scenario (3)
1991	14.37	14.20	14.75
1992	17.53	17.06	17.54
1993	20.18	19.44	19.57
1994	22.78	21.53	21.22
1995	24.39	22.58	21.77
1996	26.59	24.17	22.82
1997	30.18	27.08	25.15
1998	33.37	29.49	26.96
1999	35.40	30.62	27.38
2000	38.20	32.43	28.02

The projected imports by the year 2000 vary from 38 million and 28 million tons by the year 2000 in high and low scenarios depending upon restrictions on independent variables by assumptions.

It is very important to note that the large increasing wheat import demand will have significant impact on world wheat prices. An appropriate projection will be essential information for all decision-making agencies. The major interests will focus on long-run demand as many of China's important policies are made for the period ending at the year 2000, which definitely will be a turning point for China's national policies. Some related

---

[5]. when $\mathbf{Y_f = X_f\beta + U_f}$ ($Y_f = \beta_0 + \beta_1 X_{f1} + \beta_2 X_{f2} + \ldots \ldots + \beta_k X_{fk} + U_f$), $\hat{\mathbf{Y}} = \mathbf{Xfb}$ where $\mathbf{b} = \beta$; the interval prediction:
$\hat{Y}_f - t_{\alpha/2,(n-k)}(e'e/n-k)^{1/2}(1+X_f(X'X)^{-1}X'_f)^{1/2} < Y_f < \hat{Y}_f + t_{\alpha/2,(n-k)}(e'e/n-k)^{1/2}(1+X_f(X'X)^{-1}X'_f)^{1/2}$,
where n = number of observations, k = number of parameters (Johnston, J., Econometric Methods, McGraw-Hill Publishing Company, U.S.A., 1984, 193-198). When n is large (large sample size), the interval tends to be small. In econometrics practice, the interval usually is not calculated for large sample.

variables and potential influential factors must be considered prior to forecasting. Therefore, the forecasting of future demand was employed based on different assumed scenarios.

CHAPTER 5

SUMMARY AND CONCLUSION

5.0 Summary of the Study

The decade-long agricultural reform in China may finally bring a substantial deregulation in the grain industry in the 1990s. The increasing Chinese participation in the international grain market is inevitable and its membership in GATT is also expected by the middle of the 1990s.

The significant improvements in domestic trade administration and infra-structural facilities, high domestic grain marketing rate, increasing animal feed requirements, and shifting shares between cash and grain crops, will integrate and make the wheat trade a more controversial issue throughout the 1990s.

The objectives of this study have been achieved with significant empirical underpinnings and findings. The study emphasized not only the conventional trade consumption theory and application but also the empirical underpinnings and rationale behind the theory, which is the foundation of the conceptual framework. The introduction of a distributed lag model and quantification of policy and infra-structural elements has provided a different methodological concept for future studies.

The operational and decision-making patterns of China's wheat demand require correct specifications of empirically functional forms and sound conceptual framework. In reality, China's wheat import demand is elastic and multi-dimensionally responsive.

China's wheat imports have made a larger impact on the world wheat price than the actual influence of world wheat price on China's purchasing decisions. The main reason is that the world wheat market has been a buyer's market and China's regulated domestic supply enables China to defer its import requirements when the wheat prices are high in the world grain market. The whole concept and objective of China's wheat trade have changed from the supplement to shortage of grain supply to the supplement of high quality fine grain for diet change over the past three decades.

The empirical results of this study generated explanatory power of the related issues. The Chinese agricultural system is complex and still adjusts to absorb shocks triggered by reforms, which translates into immense influence over agricultural trade. It is also perceived that the whole agricultural sector is to experience structural changes through the course of the 1990s. In the studied models, a lagged dependent variable and policy dummy variable also functioned as constraints to reduce the substantial shock to demand caused by other variables. The consistency between the conceptual framework and empirical results are fundamental supports of the theories and assumptions employed in the study. Unlike other similar studies, the results of this study displayed that China's import demand is elastic of wheat and rice price ratio, income, exchange rate, and also infra-structural capacity in the long-run. The results of this study can be summarized as follows:

1. As Table 4.1 indicates, Equation (4.4) produces the best results with significant estimates and high R^2 among all short-run models although some of other models have acceptable statistical estimates. Equation (4.4) contains six explanatory variables: foreign

trade balance, real income, exchange rate, dummy variable, amount of grain available per capita, and transportation capacity. The coefficients of these six variables all have the correct signs and are statistically significant at the 1 percent level. Four of the six variables have an elastic effect on import demand. A 1 percent increase in real income will increase import demand by 1.203 percent while other variables remain the same. Similarly, a 1 percent increase in the exchange rate will cause a 2.15 percent decrease in the import demand; A 1 percent increase in grain availability per capita will decrease imports by 1.675 percent; A 1 percent increase in transportation capacity will increase imports by 1.464 percent. The exchange rate shows the highest elasticity in all models which indicates that the exchange rate is the most sensitive variable in the models. Real income per capita, foreign trade balance, and transportation capacity have a positive impact on the wheat imports in the applied models while all other variables display a negative impact.

2. The long-run models show very desirable properties in terms of estimates and functional form. Equation (4.7) has a R^2 value of 0.9548 and Durbin-Watson value of 2.0339. All estimated coefficients have correct signs as assumed and they are statistically significant at the 1 percent level. Lagged import demand, foreign trade balance, real income, and the dummy variable have inelastic effects while exchange rate, total grain output, and transportation capacity have elastic effects. As Table 4.3 shows, a 1 percent increase in the exchange rate will result in a 1.347 percent decrease in wheat imports while other variables remain the same. Similarly, a 1 percent increase in total grain output will decrease by 2 percent the wheat imports, and a 1 percent increase in transportation

capacity will increase wheat imports by 2.4 percent. The significant coefficient of the lagged dependant variable shows the impact of previous imports on the current year's import demand. In the long-run, the previous year's imports may have an effect on the following year's wheat stock which effectively influences the wheat importing decision-making process.

3. The log-linear models have acceptable R^2 and DW with significant estimated coefficients at the 1 percent level except GP (total grain output) in equation (4.6) and all coefficients have correct signs as assumed. However in general, the two log-linear models have shown less desirable econometric properties compared to equation (4.4) in the linear form and equation (4.7) in the distributed-lag form.

4. The forecast of future import demand for the period of 1991 to 2000 is conducted based on a long-run model in the form of equation (4.7). The projected wheat import demand of China is between 28 million to 38 million tons in low and high scenarios respectively, which is consistently lower than most projections of similar studies. The main reason for the difference is the consideration of transportation constraints and assumption of 500 million tons of grain output by year 2000 in this study which have not been assumed to be important variables in other previous studies. In fact, China's actual import performance has been shown to be consistently lower than most forecasted figures from various sources.

5.1 Implications and Issues

In both the short-run and the long-run models, variables such as foreign trade

balance, real income, dummy variable, exchange rate, grain output, and transportation capacity have statistically significant coefficients. This indicates that all of these variables jointly function to influence China's wheat import demand. The significant R^2's of all empirical models in this study show that China's wheat import demand in actual fact has a specific pattern which can be explained through the influence of several important factors.

In short-run models, the exchange rate shows the highest elasticity which is attributed to tight government control and represents a composite factor reflecting the general economic environment. Although the Chinese government managed an almost fixed exchange rate throughout the 1960s and 1970s, enormous government subsidies in the grain supply to urban residents in order to keep fixed grain prices were highly related to prices of imported wheat through the exchange rate. In the 1980s, the more market oriented exchange rate functioned as the most sensitive factor in wheat imports for the short-run period as the exchange rate has an almost instantaneous effect on all imports. The relaxation of exchange rate controls required by the economic reform in China may eventually lead to free currency conversion and make imports of wheat more expensive as more depreciation of the Chinese currency is expected. However, the reduction of wheat imports caused by depreciation of the Chinese currency will be offset to some extent by income effect especially the rapidly increasing income per capita in urban areas which has translated into increased demand for high quality wheat.

Transportation capacity shows the highest elasticity among all explanatory variables in the long-run models. Compared to other variables, transportation capacity is

the only factor which can not be improved enormously within a short period of time. As a matter of fact, China's wheat imports are consistently lower than its real demand which is due mainly to the constraints of transportation capacity including both port unloading capacity and railway transportation capacity. In contrast to the exchange rate in the short-run models, transportation capacity has the most significant impact on wheat imports in the long-run. Considering the fast-moving Chinese economy, real income, foreign trade balance, and exchange rates will not be the major constraints to China's wheat imports. Improvements to the transportation infra-structure will take, however, significant period of time and attention to catch up to demand.

Demand for fine grain, basically wheat flour in China, is definitely going to increase in the next decade. Domestic wheat production is insufficient to meet demand for both urban and rural residents. In all likelihood urban demand, especially in coastal cities, will continue to rely upon sizeable imports. There is no doubt about the potential demand , however, whether a dramatic increase in wheat imports will occur is completely dependent upon China's self-sufficiency agricultural policy and willingness to pay the bills, not the income effect on consumer side.

Overall, China is likely to move towards a freer trade environment. This transition period will be long but it has a definite direction, which is a critical guidance factor for conceptual framework development of subsequent studies. As China's wheat import depends on both domestic grain output and real demand for wheat, there are several important issues related to both grain production and demand for import which need to be discussed. The existing constraints to production increases in the Chinese agricultural

sector, such as capital and material inputs, may not be easily solved through the 1990s. Further improvement of grain supply in China also requires more deregulated grain marketing and foreign trade systems.

This study has provided some supporting evidence to the formation of empirical models of China's import demand patterns. However, there are many unsolved and challenging subjects in this area for further studies. Issues unsolved in China's wheat trade are extensive, both domestic and internationally. China's demand for wheat imports is highly interrelated with its further economic reforms and agricultural system restructuring.

World wheat markets also have many unpredictable factors and unsolved problems which are today's trade barriers. Through trade talks targeting a freer trade environment, the structure of world wheat trade is likely to experience further changes.

As more accurate and reliable statistical data from China specially some consumption structure and infra-structure data become available, further studies on China's wheat import forecasting may focus on:

1. Demand increases for wheat resulting from diet structure change and income increase of both urban and rural residents.

2. Import increases from transportation capacity improvement in the long-run.

3. Improvement of regional supply balance from more interregional grain movement.

4. Increases of wheat supply from domestic stocks.

China may soon become a dominant wheat importer in the international grain

market, however, import increases are not assumed to be dramatic. Due to import and domestic transportation costs, China has to determine the orientation of its budget: whether more interregional grain movement or more wheat imports. No matter which scenario dominates the Chinese trade policy, wheat imports will be steadily increasing and more predictable throughout the 1990s.

REFERENCES

Barker, R., Sinha, R. and Rose, B. The Chinese agricultural economy. Boulder: Westview Press, 1982.

Borsody, L. "Forecasting USSR grain imports." Food Policy 12 (1987): 94-105.

Carter, C.A. and Zhong, F. China's grain production and trade. Boulder: Westview Press, 1988.

China Statistics Bureau. China statistical yearbook, 1985. Beijing: China Statistics Publishing House.

_____. China statistical yearbook, 1989. Beijing: China Statistics Publishing House.

Conway, R. Examining intertemporal export elasticities for wheat, corn and soybeans: a stochastic coefficients approach. Washington DC: U.S. Deaprtment of Agriculture, 1987.

Desai, P. Estimates of soviet grain imports in 1980-85: alternative approaches. Washington DC: International Food Policy Research Institute, 1981.

Dorn, J.A. and Wang, X. Economic reform in China. Chicago: The University of Chicago Press, 1990.

Ennew, C.T. "A model of import demand for grain in the soviet union." Food Policy 12 (1987): 106-15.

Furtan, W.H., Bayri, T.Y., Gray, R. and Storey, G.G. Grain market outlook. The Economic Council of Canada, 1989.

Goldberg, J.R. "Grain options for China - 1990-2000." In Agricultural Reform and Development in China. Beltsville, MD: Ideals, 1990.

Goodman, S.G. China's regional development. New York: Routledge, 19--.

Grennes, T., Johnson, P.R. and Thursby, M. The Economics of world grain trade.

Gunasekera, H.D.B.H., Rodriguez, G. and Andrews, N. "Effects of alternative Chinese policies on the world grains market." Journal of Agricultural Economics 43 (1992) 440-51.

Halbrendt, C. and Gempesaw, C. "A policy analysis of China's wheat economy." American Journal of Agricultural Economics 72 (1990): 268-78.

Hinton, W. The great reverval. New York: Monthly Review Press, 1990.

International Monetary Fund. International financial statistics. Washington DC, 1979 -1989.

International Rice Council. World rice statistics. Manila, 1987.

International Wheat Council. World wheat statistics. London, 1975 and 1988.

Jonhston, J. Econometric Methods. New York: McGraw-Hill Publishing Company, 1984.

Kmenta, J. Elements of econometrics. New York: Macmillan Publishing Company, 1986.

Kula, E. "Politics, economics, agriculture and famines." Food Policy 14 (1989): 13-6.

Lardy, N.R. "Foreign trade and economic reform in China 1978-1990". U.S. Department of Agriculture, Economic Research Service, Washington DC.

_____. "China's interprovincial grain marketing and import demand". Economics Research Service, U.S. Department of Agriculture, 1990.

Minden, K. Politics and business: The Canada-China wheat trade 1960-1984. Center on

Foreign Policy and Federalism, 1985.

_____. "The politics of cerealism: the wheat trade and canadian-chinese relations." Working paper #27. The Joint Centre on Modern East Asia - University of Toronto - York University, 1983.

Mogarry, M.J. The world grain trade. Boulder: Westview Press, 1992.

OECD. Agriculture in China: prospects for production and trade. Paris, 1985.

Phillips, P.W.B. Wheat, Europe and the Gatt. London: Pinter Publishers, 1990.

Prybyla, J.S. Reform in China and other socialist economies. Washington DC: The AEI Press, 1990.

Reynolds, B.L. Chinese economic reform. San Diego, CA: Academic Press Inc., 1988.

Schmitz, A. and Bawden, D. L. "The world wheat economy: an empirical analysis." Giannini Foundation Monograph # 32, 1973.

Schwatz, N.E. and Ralston, K. "The impact of chinese wheat imports on world price and trade." Agricultural economics research paper. Department of Agricultural Economics, Cornell University, 1983.

Stone, B. "Chinese fertilizer application in the 1980s and 1990s: issues of growth, balance, allocation, efficiency and response". In China's economy looks toward the year 2000, Vol. 1, ed. U.S. Congress Joint Economic Committee. Washington DC: U.S. Government Printing Office.

Sun, J. The economic geography of China. New York: Oxford University Press, 1988.

Surls, F.M. "The dynamics of China's wheat trade."

U.S. Department of Agriculture. China: situation and outlook report. Washington DC: Economics Research Service, July 1987 and July 1990.

_____. China: agriculture and trade report. Situation and Outlook Series. Washington DC: Economics Research Service, various issues.

Walker, K.R. Food grain procurement and consumption in China. Cambridge MA: Cambridge University Press, 1984.

Woodhams, R. Wheat to 1991-adapting to over supply. The Economist Intelligence Unit, 1986.

World Bank. China: agriculture to year 2000. Washington DC, 1984.

_____. China: options for reform in the grain sector. Washington DC, 1991.

_____. "Grain consumption in China: structure and trends." Working paper No. 1. Washington DC, 1990.

_____. "Grain marketing , price policy and foreign trade." Working paper No. 7. Washington DC, 1990.

_____. "Grain production prospects and constraints." Working paper No. 3. Washington DC, 1990.

Xu, G. and Peel, L.J. The agriculture of China. New York: Oxford University Press, 1991.

Yeh, M.H."Demand functions for fertilizer in Canada". Canadian Journal of Agricultural Economics Vol. VIII, No.2 (1960) 53-63.

"The labor market with particular reference to Canadian agriculture". Journal of Farm Economics Vol.49, No.5 (1967): 1257-1267.

APPENDIX

Table 1. China's Grain Production (1961-1990), 1,000 mt

Year	Total Grain	Wheat Output	Rice Output	Year	Total Grain	Wheat Output	Rice Output
1961	143,154	14,250	53,640	1976	286,305	50,385	125,810
1962	155,310	16,665	62,985	1977	282,725	41,075	128,565
1963	165,722	18,475	73,765	1978	304,765	53,840	136,930
1964	187,500	20,840	83,000	1979	332,115	62,730	143,750
1965	194,525	25,220	87,720	1980	320,560	55,210	139,910
1966	214,000	25,280	95,390	1981	325,020	59,640	143,955
1967	217,820	28,485	93,685	1982	354,500	68,470	161,595
1968	209,055	27,455	94,530	1983	387,275	81,390	168,865
1969	210,970	27,285	95,065	1984	407,310	87,815	178,255
1970	239,955	29,185	109,990	1985	379,180	85,805	168,569
1971	250,140	32,575	115,205	1986	391,512	90,040	172,220
1972	240,480	35,985	113,355	1987	404,733	87,768	174,260
1973	264,935	35,225	121,735	1988	399,300	85,730	169,110
1974	275,270	40,865	123,905	1989	414,422	93,864	180,130
1975	284,515	45,310	125,560	1990	451,841	99,356	189,330

Source: China Statistical Yearbook, 1989, 1991.

Table 2. China's Grain Imports (1961-1990), 1,000 mt

Year	Total Imports	Wheat	Other	Year	Total Imports	Wheat	Other
1961	5,810	3,882		**1976**	2,367	2,022	
1962	4,923	3,536		**1977**	7,345	6,876	
1963	5,952	5,588		**1978**	8,833	7,667	
1964	6,570	5,369		**1979**	12,355	8,710	
1965	6,405	6,073		**1980**	13,429	10,972	
1966	6,438	6,214		**1981**	14,812	13,070	
1967	4,702	4,395		**1982**	16,117	13,534	
1968	4,596	4,451		**1983**	13,435	11,019	
1969	3,786	3,740		**1984**	10,645	10,000	
1970	5,360	5,302		**1985**	6,171	5,630	
1971	3,173	3,022		**1986**	7,280	5,750	
1972	4,756	4,334		**1987**	16,280	13,200	
1973	8,128	6,299		**1988**	15,330	14,550	
1974	8,121	5,383		**1989**	16,580	14,880	
1975	3,735	3,491		**1990**	13,720	12,530	

Source: China Statistical Yearbook, 1989, 1991.

Table 3. China's Grain Exports (1961-1990), 1,000 mt

Year	Grain Exports			Year	Grain Exports		
	Total	Rice	Other		Total	Rice	Other
1961	1,355	291		**1976**	1,765	1,427	
1962	1,031	334		**1977**	1,657	1,183	
1963	1,490	452		**1978**	1,877	1,678	
1964	1,821	658		**1979**	1,651	1,459	
1965	2,417	631		**1980**	1,618	1,313	
1966	2,885	1,264		**1981**	1,261	683	
1967	2,994	1,198		**1982**	1,251	800	
1968	2,601	957		**1983**	1,963	826	
1969	2,238	801		**1984**	3,440	1,160	
1970	2,119	978		**1985**	7,404	1,006	
1971	2,618	913		**1986**	7,149	950	
1972	2,926	861		**1987**	7,370	1,022	
1973	3,893	1,986		**1988**	7,180	698	
1974	3,644	1,872		**1989**	6,560	315	
1975	2,806	1,935		**1990**	5,830	330	

Source: China Statistical Yearbook, 1989, 1991.

Table 4. China's Grain Yield (1961-1990), kg/ha

Year	Grain Yield			Year	Grain Yield		
	Grain	Wheat	Rice		Grain	Wheat	Rice
1961	1179	557	2041	**1976**	2371	1773	3474
1962	1277	692	2338	**1977**	2348	1464	3619
1963	1373	777	2662	**1978**	2527	1845	3978
1964	1536	820	2803	**1979**	2785	2137	4244
1965	1626	1021	2941	**1980**	2734	1889	4130
1966	1769	1057	3125	**1981**	2827	2107	4324
1967	1827	1126	3078	**1982**	3115	2447	4876
1968	1800	1113	3162	**1983**	3396	2802	5096
1969	1794	1084	3124	**1984**	3608	2969	5373
1970	2012	1146	3399	**1985**	3483	2937	5256
1971	2070	1271	3299	**1986**	3525	3045	5340
1972	1984	1368	3226	**1987**	3630	3045	5415
1973	2187	1332	3469	**1988**	3630	2985	5280
1974	2275	1510	3489	**1989**	3690	3150	5505
1975	2350	1638	3514	**1990**	3975	3225	5730

Source: China Statistical Yearbook, 1989, 1991.

Table 5. China's Crop Areas (1961-1990), 1,000 ha

Year	Planted Area			Year	Planted Area		
	Total	Wheat	Rice		Total	Wheat	Rice
1961	121,433	25,572	26,276	**1976**	120,743	28,417	36,217
1962	121,621	24,075	26,935	**1977**	120,400	28,065	35,526
1963	120,741	23,771	27,715	**1978**	120,587	29,183	34,421
1964	122,103	25,408	29,607	**1979**	119,263	29,357	33,873
1965	119,627	24,709	29,825	**1980**	117,234	29,228	33,879
1966	120,988	23,919	30,529	**1981**	114,958	28,307	33,295
1967	119,230	25,299	30,436	**1982**	113,463	27,955	33,071
1968	116,157	24,658	29,894	**1983**	114,047	29,050	33,173
1969	117,604	25,162	30,432	**1984**	112,884	29,576	33,178
1970	119,267	25,458	32,358	**1985**	108,845	29,218	32,070
1971	120,846	25,639	34,918	**1986**	110,932	29,616	32,266
1972	121,209	26,302	35,143	**1987**	111,268	28,798	32,193
1973	121,156	26,439	35,090	**1988**	110,123	28,785	31,987
1974	120,976	27,061	35,512	**1989**	112,204	29,841	32,701
1975	121,062	27,661	35,729	**1990**	113,466	30,753	33,065

Source: China Statistical Yearbook, 1989, 1991.

Table 6. China's Foreign Trade alance and Income (1961-1990)

Year	Income Index	Yuan/ US$	Trade Balance	Year	Income	Yuan/ US$	Trade Balance
1961	140	246.18	40	**1976**	374.5	194.14	270
1962	130.9	246.18	320	**1977**	403.7	185.78	380
1963	144.9	246.18	380	**1978**	453.4	168.36	-1,140
1964	168.8	246.18	370	**1979**	485.1	155.49	-2,010
1965	197.4	246.18	210	**1980**	516.3	149.84	-1,900
1966	231.0	246.18	120	**1981**	541.5	170.50	-10
1967	214.3	246.18	120	**1982**	585.8	189.25	3,040
1968	200.3	246.18	150	**1983**	644.2	197.57	840
1969	239.0	246.18	370	**1984**	731.9	232.70	-1,270
1970	294.6	246.18	-70	**1985**	830.6	293.67	-14,900
1971	315.3	246.11	440	**1986**	894.5	345.28	-11,960
1972	324.3	224.51	580	**1987**	985.7	372.21	-3,780
1973	351.2	198.94	660	**1988**	1,097.2	372.21	-7,760
1974	355.2	196.12	-670	**1989**	1,137.2	376.59	-6,600
1975	384.7	185.98	-230	**1990**	1,191.6	478.38	8,750

Source: China Statistical Yearbook, 1989, 1991.

Income index: Year 1952 is base year, income = 100 in 1952,

Yuan/US$: exchange rate, Yuan: 100 US$,

Trade Balance: (+) indicates surplus while (-) indicates deficit, unit is million US$.

Table 7. World Grain Prices (1961-1990), US$/mt

Year	Wheat	Rice	Year	Wheat	Rice
1961	62	137	**1976**	134	254
1962	63	153	**1977**	105	272
1963	65	143	**1978**	131	368
1964	68	138	**1979**	163	334.4
1965	60	136	**1980**	176	433.7
1966	63	163	**1981**	177.7	482.8
1967	66	206	**1982**	161.5	293.6
1968	63	202	**1983**	158.1	276.8
1969	58	187	**1984**	153.3	252.3
1970	55	144	**1985**	137.8	217.3
1971	62	129	**1986**	114.9	210.2
1972	70	147	**1987**	114.5	229.8
1973	138	350	**1988**	146.4	301.6
1974	181	542	**1989**	170.1	320.3
1975	151	363	**1990**	136.8	286.8

Source: UNCTAD Handbook of International Trade and Development Statistics, 1983, p61; UNCTAD Commodity Yearbook 1991, p394.

Wheat: United States, No.2, Hard Red Winter (ordinary), f.o.b. Gulf.

Rice: Thailand, white, 5% broken, f.o.b. Bangkok.

Table 8. China's Domestic Grain Prices (1961-1990)

Year	Wheat	Rice	Year	Wheat	Rice
1961	188	176	**1976**	215	205
1962	188	178	**1977**	215	205
1963	186	174	**1978**	215	205
1964	186	174	**1979**	262	248
1965	187	178	**1980**	262	248
1966	215	203	**1981**	262	248
1967	215	203	**1982**	262	248
1968	215	203	**1983**	262	248
1969	215	203	**1984**	262	248
1970	215	203	**1985**	262	252
1971	215	203	**1986**	273	268
1972	215	203	**1987**	283	304
1973	215	203	**1988**	326	364
1974	215	204	**1989**	397	476
1975	215	205	**1990**	365	440

Source: China Statistical Yearbook, 1989, 1991.

Table 9. China's Population and Growth Rate (1961-1990)

Year	Populaion	Growth Rate	Year	Population	Growth Rate
1961	658.59	0.378	**1976**	937.17	1.266
1962	672.95	2.699	**1977**	949.74	1.206
1963	691.72	3.333	**1978**	962.59	1.200
1964	704.99	2.764	**1979**	975.42	1.161
1965	725.38	2.838	**1980**	987.05	1.187
1966	745.42	2.622	**1981**	1,000.72	1.455
1967	763.68	2.553	**1982**	1,016.54	1.568
1968	785.34	2.738	**1983**	1,030.08	1.329
1969	806.71	2.608	**1984**	1,043.57	1.308
1970	829.92	2.583	**1985**	1,058.51	1.426
1971	852.29	2.333	**1986**	1,075.07	1.557
1972	871.77	2.216	**1987**	1,093.00	1.661
1973	892.11	2.089	**1988**	1,110.26	1.573
1974	908.59	1.748	**1989**	1,127.04	1.504
1975	924.2	1.569	**1990**	1,143.33	1.439

Source: China Statistical Yearbook, 1991.

Population measurement: million.

Growth rate measurement: per centage.

Table 10, China's Land Classification

Classification	Area	percentage of total
Total Area (km^2)	9,600,000	
Cultivated Area (ha.)	95,670,000	10.0
Waste Land (ha.)	108,000,000	
Clamable (ha.)	35,350,000	
Grassland (ha.)	319,080,000	33.2
Forest (ha.)	124,650,000	13.0
Water (fresh) (ha.)	16,640,000	1.7

Source: China Statistical Yearbook, 1991.