LABOR MIGRATION IN TAIWAN

by

Ji-Ping Lin

LABOR MIGRATION IN TAIWAN

By

JI-PING LIN, B.Sc. and M.Sc.

A Thesis
Submitted to the School of Graduate Studies
in Partial Fulfillment of the Requirements
for the Degree
Doctor of Philosophy

McMaster University

DOCTOR OF PHILOSOPHY (1998) McMASTER UNIVERSITY
(School of Geography and Geology) Hamilton, Ontario

TITLE: Labor Migration in Taiwan

AUTHOR: Ji-Ping Lin,
B.Sc. (National Taiwan University, Taiwan) and
M.Sc. (National Central University, Taiwan)

SUPERVISOR: Professor K.L. Liaw

NUMBER OF PAGES: xiv, 275

PREFACE

This thesis is a so-called "sandwich thesis" in the sense that most of the chapters have been written as self-contained papers for submission to refereed journals. Chapters 4-7 are also the results of collaborative research with my supervisor, Dr. Kao-Lee Liaw, and a colleague at Academia Sinica, Taiwan, Dr. Ching-Lung Tsay.

According to the rules of the School of Graduate Studies, the author is obliged to document clearly his major contribution to the coauthored chapters of the thesis. As a whole, the author undertook most of the research works during his doctoral study at McMaster University. Specifically, for Chapter 4 - 6 (coauthored with Dr. Liaw), the author undertook the initial works (including the collection and analyses of research data and the writing of first draft) and the subsequent revision works in collaboration with the coauthor; for Chapter 7 (coauthored with Dr. Liaw and Dr. Tsay), the author's contributions include the collection and analysis of data, the creation of the linked migration data, the formation of research hypotheses, the writing of first draft, and the subsequent revision tasks working with the coauthors.

Most of the chapters of this thesis are also designed as conference papers. Chapter 7 was presented by the author at the 1997 CRSA (Canadian Regional Science Association) Annual Meetings in St. John's. It had also been accepted for publication by Environment and Planning A. Chapter 5 was presented by the author at the 1998 COSSH (Congress of Social Sciences and Humanities) Annual Meetings in Ottawa.

ABSTRACT

This thesis consists of three parts. ***The first part*** (Chapter 3) is to achieve a comprehensive understanding of the interrelationships among migration, the evolution of the settlement system, and the socioeconomic development in Taiwan over the past four hundred years (1600-1990), with an emphasis on the impacts of developmental strategy and government policy. The major finding is that the migration process in Taiwan appears to be highly responsive to the changing socioeconomic context.

The second part (Chapter 4-6) involves the studies of (1) life-time migrations and (2) 1985-90 primary, return, and onward migrations of the labor force in Taiwan, based on the 1990 Taiwanese census. The main theme of these analyses is to assess the responsiveness of labor migration to the labor market forces and to the economic restructuring and globalization that took place in the 1980s. The main findings are (1) that primary labor migration played a much greater role than did onward and return labor migrations in affecting the transfers of human resources and (2) that the three types of labor migration responded in a rational way to the effects of patriarchal value system, educational attainment, location-specific capital, market forces, and economic restructuring and globalization.

The third part (Chapter 7) is devoted to the analysis of the behaviors of fast repeat labor migration in Taiwan, based on the linked migration data. The main findings are (1) that the most important factors of fast repeat migrations turned out to be the chronicity and patriarchal ideology, (2) that those with a ***limited*** labor market knowledge and an ***unsuccessful*** job search are more prone to make a fast return migration, and (3) that the more ***experienced*** and more ***successful*** previous migrants are more prone to make a fast onward migration.

ACKNOWLEDGMENTS

First of all, I would like to express my sincere gratitude to the members of my Supervisory Committee: Dr. Kao-Lee Liaw (Supervisor), Dr. William P. Anderson, Dr. Pavlos Kanaroglou. This thesis has been greatly enhanced by their professionalism. Dr. Eric Moore's constructive comments on the thesis are also much appreciated. In addition, I could not have been successful at my doctoral research at McMaster without the support of the School and University.

I also owe much to Dr. Ching-Lung Tsay of Academia Sinica and Dr. Nora Nan-Hong Chiang of National Taiwan University. Their encouragement served as the basis of my pursuing doctoral study. Also, my research would have been impossible without the assistance of Taiwan's Census Bureau and Statistic Bureau of DGBAS and the help of my former colleagues in both Bureaus. I would like to take this opportunity to express my sincere thanks to them for their enthusiasm.

The love and patience of my parents and sisters were the most important spiritual support during the most dismal period, when my research was most challenging. Their words of wisdom not only helped cool me off, but also enabled me to move steadily toward finishing my study. This thesis is dedicated to them.

TABLE OF CONTENTS

Preface iii

Abstract iv

Acknowledgments v

Table of Contents vi

List of Tables x

List of Figures and Maps xiii

Chapter 1 Introduction 1
- 1.1 Context 1
- 1.2 Objectives, Data and Methodology 2
- 1.3 Scope of the Research 4
- 1.4 Structure of the Thesis 5

Chapter 2 A Review of Migration Literature 13
- 2.1 Introduction 13
- 2.2 Major Economic Theories of Migration 14
  - 2.2.1 Wage Differential Theory 15
  - 2.2.2 Human Capital Theory 16
  - 2.2.3 Expected Income Theory 20
  - 2.2.4 New Economics of Migration 21
  - 2.2.5 Dual Labor Market Theory 25
  - 2.2.6 World Systems Theory 26
- 2.3 Type of Migration, Determinants and Selectivity 28
  - 2.3.1 Type of Migration: Primary, Return, and Onward Migration 28
  - 2.3.2 Determinants and Selectivity of Migration 30
- 2.4 Migration and Market Adjustment 34
- 2.5 Conclusion 39

Chapter 3 Migration, Settlement System, and Socioeconomic Development in Taiwan: 1600-1990 **42**
3.1 Introduction 42
3.2 The Era of Immigration and Frontier-type Society: 1600-1894 43
3.3 The Era of the Japanese Administration and Infrastructural Development: 1895-1945 49
3.4 The Era of Chaotic Times and Retrogression: 1946-1950 55
3.5 The Era of Rehabilitation: 1951-1960 58
3.6 The Era of Economic Takeoff: 1961-1973 63
3.7 The Era of Industrial Restructuring: 1974-1984 68
3.8 The Era of Development Toward a Pluralistic and Open System: 1985-1990 73
3.9 Conclusion 78

Chapter 4 Labor Migrations in Taiwan: Characterization and Interpretation Based on the Data of the1990 Census **84**
4.1 Introduction 84
4.2 Data and Definitions of Migrants 87
4.3 Patterns of Life-time Labor Migrations 89
4.4 Patterns of Labor Migrations in the 1985-90 Period 94
4.4.1 Interregional Labor Migrations 94
4.4.2 Interprefectural Labor Migrations 97
4.5 Educational Selectivity of the 1985-90 Interprefectural Labor Migration 102
4.5.1 Educational Selectivity: Primary, Onward, and Return Migrations 102
4.5.2 Impacts on the Prefectural Human Resources 105
4.6 Conclusion 112

Chapter 5 Primary Migration of the Taiwanese Young Labor Force in the Context of Economic Restructuring and Globalization: An Explanation Based on the 1990 Census **114**
5.1 Introduction 114
5.2 Data and Methodology 117
5.3 Specification of the Explanatory Variables 122
5.4 Estimation Results of the Departure Model 125
5.5 Estimation Results of the Destination Choice Model 132
5.6 Concluding Discussion 138
Appendix 5.1 Definition of the Explanatory Variables in the Nested Logit Model 142

Chapter 6 Return and Onward Migrations of the Young Labor Force in Taiwan: Evidence from the Data of the1990 Census 146
6.1 Introduction 146
6.2 Data and Statistical Model 149
6.3 Selection of the Explanatory Factors 154
6.4 Findings from the Departure Model 157
6.5 Findings from the Return/Onward Model 163
6.6 Findings from the Onward Destination Choice Model 171
6.7 Conclusion 178

Chapter 7 Determinants of Fast Repeat Migrations of the Labor Force: Evidence from the Linked National Survey Data of Taiwan 181
7.1 Introduction 181
7.2 Theories and Hypotheses 184
7.2.1 The Yezer-Thurston Theory 184
7.2.2 The Da Vanzo-Morrison Theory 186
7.2.3 Additional Considerations: Budget Constraint and Societal Context 187
7.2.4 The Hypotheses 188
7.3 Data, Measurements, and Methodology 193
7.3.1 Data and Measurements 193
7.3.2 The Statistical Model and Methodology 197
7.3.3 The Explanatory Factors 199
7.4 Empirical Findings 202
7.5 Conclusion 211

Chapter 8 Conclusion 215
8.1 Introduction 215
8.2 Labor Migration and the Evolution of Settlement System 216
8.3 Impacts of the 1985-90 Labor Migration on the Spatial Pattern of Human Resources 219
8.4 Characteristics and Determinants of the 1985-90 Labor Migrations 220
8.5 Characteristics and Determinants of Fast Repeat Labor Migrations 224
8.6 Contrasts between 1-year and 5-year Repeat Labor Migrations 225
8.7 Overall Conclusion 230
8.8 Directions of Future Research 231

Appendix 1 Computational Procedures for the Aggregate Predictions of In- and Out-migration Volumes 234

Appendix 2 Computational Procedures for the Aggregate Predictions and Asymptotic Distributions of In- and Out-migration Volumes and Rates: Using Gauss-language as an Example 236

Bibliography 264

LIST OF TABLES

Chapter 3

Table 3.1. Percentage Share of Lifetime In-migrants and Out-migrants by Prefecture: Based on the 1920, 1930 and 1940 Censuses. 54

Table 3.2. Average Annual Rate of Net Migration for the Periods of 1951-62,1963-74, 1975-80, and 1985-90 by Prefecture. 62

Chapter 4

Table 4.1. The Effects of Inter-regional Life-time Migrations on the Redistribution of the Taiwanese Labor Force Aged 20+ in 1990: Based on the 1990 Population Census, Taiwan. 90

Table 4.2. Inter-regional Net Transfers of the Taiwanese Labor Force Aged 20+ in 1990 from Native Domicile to the 1990 Residence: Based on the 1990 Population Census, Taiwan. 92

Table 4.3. Flows of the Inter-regional Life-time Migrants of the Taiwanese Labor Force Aged 20+ in 1990 from Native Domicile to the 1990 Residence: Based on the 1990 Population Census, Taiwan. 93

Table 4.4. Volumes and Rates of Inter-regional Primary, Return, and Onward Migrations of the Taiwanese Labor Force Aged 20+ in 1990 : Based on the 1990 Population Census, Taiwan. 95

Table 4.5. Impact of Inter-prefectural Labor Migration on the Spatial Allocation of the Taiwanese Labor Force Aged 20+ in 1990 by Type of Migration: Based on the 1990 Population Census, Taiwan. 99

Chapter 5

Table 5.1. Estimation Results of the Departure Model for the Native-born

Labor Force Aged 25-29 : Based on the 1990 Population Census, Taiwan. 127

Table 5.2. The Observed and Predicted Numbers of Migrants and Departure Rates for the Native-born Labor Force Aged 25-29 by Sex and Marital Status, Education, Breadwinner Status, Industry, Occupation, and Origin : Based on the 1990 Population Census, Taiwan. 131

Table 5.3. Estimation Results of the Destination Choice Model for the Primary Migrants in the Labor Force Aged 25-29: Based on the 1990 Population Census, Taiwan. 133

Table 5.4. The Observed and Predicted Destination Choice Proportions of the Primary In-migrants in the Labor Force Aged 25-29 by Marital Status and Sex, Education, Breadwinner Status, Industry, and Occupation: Based on the 1990 Population Census, Taiwan. 135

Appendix Table 5.1. The Ecological Variables used for the Analyses of Primary Migration of the Labor Force in Taiwan, 1985-90. 145

Chapter 6

Table 6.1. Estimation Results of the Departure Model for the Non-native Labor Force Aged 25-29: Based on the 1990 Population Census, Taiwan. 159

Table 6.2. Observed and Predicted Rates of Return and Onward Migrations for the Non-native Labor Force Aged 25-29 by Sex and Marital Status, Education, Breadwinner Status, Industry, Occupation, Origin, and Distance to the Native Domicile : Based on the 1990 Census, Taiwan. 162

Table 6.3. Estimation Results of the Return/Onward Model for the Non-native Labor Force Aged 25-29 : Based on the 1990 Population Census, Taiwan. 165

Table 6.4. The Observed and Predicted Proportions of Return In-migrants in the Labor Force Aged 25-29 by Marital Status and Sex,

Education, Breadwinner Status, Industry, Occupation, and Origin: Based on the 1990 Population Census, Taiwan. 169

Table 6.5. Estimation Results of the Destination Choice Model for the Non-native Onward Migrants in the Labor Force Aged 25-29: Based on the 1990 Population Census, Taiwan. 172

Table 6.6. The Observed and Predicted Destination Choice Proportions of Onward In-migrants in the Labor Force Aged 25-29 by Marital Status and Sex, Education, Breadwinner Status, Industry, Occupation, and Origin: Based on the 1990 Population Census, Taiwan. 176

Chapter 7

Table 7.1. Estimation Result of Multivariate Logit Model for Job-related Repeat Migration of the Labor Force Aged 15-64: Based on the Linked National Survey Data of Taiwan. 207

Table 7.2. Observed and Predicted Rates of Job-related Repeat, Return, and Onward Migrations for Labor Force Aged 15-64: Based on the Linked National Survey Data of Taiwan. 208

LIST OF FIGURES AND MAPS

Chapter 1

Appendix Map 1.1. Regions and Prefectures, Taiwan. 9

Appendix Map 1.2. The 1992 Population Settlement System, Taiwan. 10

Appendix Map 1.3. The 1992 Urbanized Areas, Taiwan. 11

Appendix Map 1.4. The 1992 Metropolitan Areas, Taiwan. 12

Chapter 3

Figure 3.1. Population Size of Taiwan: 1951-90. 60

Figure 3.2. Sectoral Percentage Share in the Total Labor Force of Taiwan: 1951-90. 60

Figure 3.3. Sectoral Percentage Share in GDP of Taiwan: 1951-90. 60

Figure 3.4. Unemployment Rate of Taiwan: 1951-90. 60

Figure 3.5. Economic Growth Rate of Taiwan: 1951-90. 60

Figure 3.6. Gross Domestic Savings and Investment, and Gross Net Savings Surplus of Taiwan: 1951-90. 60

Figure 3.7. Flows of Labor Migrants in the 1930s-70s. 81

Figure 3.8. Flows of Labor Migrants in the 1980s. 82

Chapter 4

Figure 4.1. Age-specific Educational Selectivity of Inter-prefectural Migration of the Taiwanese Labor Force Aged 20+ in 1990: Overall Pattern and Primary, Return, and Onward Migrations. 103

Figure 4.2. Impact of Inter-prefectural Migration of the Labor Force Aged 20+ (in 1990) on the Spatial Human Capital Stock by Type of Migration : Based on the 1990 Population Census, Taiwan.
(Panel A1, A2, B1, and B2) 106
(Panel C1, C2, D1, and D2) 108
(Panel E1 and E2) 111

Chapter 7

Figure 7.1 The Administrative Districts of Taiwan used to Define Fast Repeat Migrations. 195

Figure 7.2. Predicted Probabilities of Fast Repeat, Return, and Onward Migrations of the "Mean Person". 209

Chapter 8

Figure 8.1. Effects of Previous Migration Distance on 1-year Return and Onward Migration. 226

Figure 8.2. Effects of Previous Migration Distance on 5-year Return and Onward Migration. 227

Figure 8.3. Effects of Educational Attainment on 1-year Return and Onward Migration. 228

Figure 8.4. Effects of Educational Attainment on 5-year Return and Onward Migration. 229

Chapter 1

Introduction

1.1 Context

In the words of a well-known Taiwan specialist, Taiwan has achieved "its well-deserved reputation as the most successful developing society to appear on the global stage since World War II" (Ranis 1992, pp.13). Its per capita income had increased from a very low level in the early 1950s to the level of US$13,000 by 1995, and the share of its GDP by the agricultural sector had been reduced to less than 4% nowadays (DGBAS 1996). Although there have been severe constraints and serious setbacks (Hsu 1980; Gold 1986), Taiwan has succeeded in modernization and economic development in the past four decades (Galenson 1979; Copper 1988; Ranis 1992). Its experience, perhaps more than that of Japan, may provide helpful lessons to the Less Developed Countries. By being rather successful in switching from traditional to high-tech industries since the 1980s (Kuo 1983; Li 1988), its experience may also deserve the attention of policy-makers in the More Developed Countries, especially those that have great difficulties in making such a transition.

There are some excellent studies on the development of Taiwan that have yielded useful lessons for Taiwan itself and for other countries (Galenson 1979; Kuo 1983; Li 1988; Gold 1986; Clark 1989; Ranis 1992). However, with few exceptions (e.g. Speare et al 1988), most of these studies are non-spatial in the sense that they do not reveal important information on the spatial aspects of labor market and the rapid changes in the settlement system that accompanied the economic development. In light of a rather common problem

of extensive rural poverty and massive urban unemployment in many Less Developed Countries (Todaro 1985), the spatial dimension of the economic development of Taiwan, especially labor migration and its contribution to the establishment of Taiwan's economic base nowadays, is clearly worthy of careful analysis.

The emergence of new economic opportunities is neither a random nor an uniform spatial process. Rather, it has always been concentrated in a few, but not necessarily the same locations. Migration of labor between regions with few opportunities and regions with expanding opportunities is an important process of market adjustment that helps determine whether economic development will succeed or fail. Furthermore, being highly selective, labor migration may result in serious socioeconomic problems (e.g. a persistent decline in the quality and quantity of human resources in peripheral regions, and overcrowding in major growth poles) that may compel government to adopt various interventions and counter-measures. For designing policies to improve the efficiency of market adjustment and to deal with its undesirable consequences, it is important to have an in-depth understanding of the nature of labor migration.

1.2 Objectives, Data and Methodology

The main purpose of this thesis is to study ***labor migration in Taiwan*** and its interactions with the socioeconomic developments of the state, with a particular emphasis on the 1980s when Taiwan's economy went through a major transformation. The ***objectives*** are (1) to explore the relationships between labor migration and socioeconomic changes, (2) to identify its characteristics and determinants, and (3) to assess its impact on the quantity and quality of human resources in different regions of Taiwan. To obtain in-depth insights into migration process, flows of labor migration are decomposed into three categories:

primary migration (migration of the native-born labor force), return migration (migration of the non-native labor force back to their "home" region), and onward migration (migration of the non-native labor force to a place other than their "home" region).

To achieve these objectives, this research depends heavily on the analyses of two sets of ***micro migration data***. The first set is ***the 1990 Taiwanese Population and Housing Census*** which will be termed in short as "the 1990 Taiwanese census" or simply as "the 1990 census" in the subsequent chapters. The main advantage of using census is its comprehensive inclusion of the population in Taiwan. The other data set comes form official sampling surveys: ***the 1980-89 October-rounds of the monthly Survey of Human Resources,*** which contains a set of supplementary questions on internal migration in Taiwan. In these surveys, questions on migration are very professionally designed and the quality of migration information clearly far surpasses that of census, mainly because most information is recorded prior to the incidence of migration. To make the survey data useful for studying repeat migrations, the author puts substantial efforts to link individual records of these surveys together, creating a ***quasi-longitudinal data set***, which will be termed as "the linked (migration) data" in short thereafter. The linked migration data set has an advantage of enabling us to control for explanatory factors prior to the incidence of migration more precisely, but its disadvantage lies in its smaller sample size.

Except for descriptive analyses, the underlying ***methodology*** of the thesis is embedded within the random utility framework of micro-level discrete choice as well as other statistical principles that will be described in the subsequent chapters. Because macro phenomena are just the aggregate results of individual decision outcomes, a methodology for generating ***aggregate*** migration flows and their ***statistical asymptotic distributions*** is also

developed during the work of this research. The aggregate migration figures shown in the subsequent chapters are all derived from the same computational methodology, which is summarized in Appendix 1. The Gauss-language source codes implementing this methodology are shown in Appendix 2.

1.3 Scope of the Research

This research has three parts. ***The first part*** (Chapter 3) is to achieve a comprehensive understanding by describing and characterizing the interrelationships among migration, evolution of settlement system, and socioeconomic developments in Taiwan over the past four hundred years (1600-1990), with an emphasis on the impacts of developmental strategy and government policy. The research is mainly based on the synthesis of those findings by historians, economists, and other social scientists. Some post-1910s time-series of migration data and economic indicators are also used to facilitate explanations. It is important to note that this historical study provides the groundwork for achieving a better understanding of labor migrations in Taiwan in the 1980s.

The second part (Chapter 4, 5, and 6) involves the study of life-time migrations as well as 1985-90 primary, return, and onward migrations of the labor force in Taiwan, based on the 1990 Taiwanese census. A descriptive analysis of (1) life-time migrations and (2) the 1985-90 primary, return, and onward migrations of the labor force (Chapter 4) is to explore (1) the basic properties of regional labor markets, (2) the efficiencies in the transfers of labor among these markets, and (3) the effect of educational selectivity and the role of labor migration in affecting the quantity and quality of regional human resources. Based on the framework of discrete choice models, multivariate analyses are used to identify and assess determinants of primary migration (Chapter 5) and return and onward migrations (Chapter

6) of the young labor force aged 25-29. The main theme of these analyses is to assess the responsiveness of labor migration to labor market forces and to the economic restructuring and globalization that took place in the 1980s.

In light of the fact that the nature of fast repeat migration tends to differ substantially from non-fast repeat migration, ***the third part*** (Chapter 7) is devoted to the analysis on the behaviors of fast repeat labor migration in Taiwan, based on the linked migration data. The main tasks of this part are (1) to explore the links between fast repeat migration and individual adjustment process in the market, (2) to identify the effects of personal characteristics and past employment and migration experiences (e.g. the effects of number of previous moves and previous migration distance) on the propensity of making fast repeat migration, and (3) to compare the findings in Taiwan with those found in North America.

1.4 Structure of the Thesis

The thesis, including this introduction, consists of 8 chapters. Several ***appendix maps*** are shown at the end of Chapter 1 to facilitate the reading of the subsequent chapters and to depict population geography of Taiwan in the early 1990s. These maps include Regions and Prefectures of Taiwan (Appendix Map 1.1), the1992 Population Settlement System of Taiwan (Appendix Map 1.2), the 1992 Urbanized Areas of Taiwan (Appendix Map 1.3), and the 1992 Metropolitan Areas of Taiwan (Appendix Map 1.4). Following the literature review in Chapter 2, the empirical results of this research are reported in Chapters 3-7. Chapter 8 is the overall conclusion. Note that Chapters 3-7 are designed as self-contained papers for submission to professional journals and hence contain some overlapping material. The thesis is structured as follows.

Chapter 2 is a ***review of literature on migration***. The work of review focuses at first on the four major schools of economic theories of migration, including the neoclassical theories, the new economics of migration, the dual labor market theory, and the theory of world systems, with an emphasis on the contrast between their policy implications. Next, the review work is switched to characterize and distinguish the nature of primary, return and onward migration, and their determinants and selectivity, with an emphasis on the importance of information-related effects (previous migration distance and education) in triggering return and onward migrations. Finally, the work reviews findings on the relation between migration and market adjustment.

Based on previous research and time-series of macro migration data and economic indicators, ***Chapter 3*** aims at exploring the interrelationship among ***migration, settlement system, and socioeconomic development*** over the past four hundred years (1600-1990), with an emphasis on the impact of developmental strategy and government policy. According to major external and internal socioeconomic and political changes, the discussions are divided into the following periods: (1) the era of immigration and frontier-type society (1600-1894); (2) the era of the Japanese administration and infrastructural development (1895-1945); (3) the era of chaotic times and retrogression (1946-1950); (4) the era of rehabilitation (1951-1960); (5) the era of economic takeoff (1961-1973); (6) the era of industrial restructuring (1974-1984); and (7) the era of development toward a plural and open system (1985-90).

Chapter 4 reports the results of descriptive analyses on ***life-time migration*** and ***1985-90 migration of the labor force in Taiwan***, based on the 1990 census. The former is to demonstrate the cumulative effects of migrations that had occurred through several decades, whereas the latter aims at showing migrations that can be better linked to the socioeconomic

conditions in the 1980s. To gain better insights into the transfer of human resources via migration, the 1985-90 labor migrations are decomposed into three categories: primary, return, and onward migrations. In light of the growing importance of economic restructuring and globalization in the 1980s, the work of this chapter also contrasts educational selectivity of migration and explores impacts of labor migrations on the spatial variations in the quantity and quality of human resources.

Chapter 5 focuses on the ***primary migration of the young Taiwanese labor force*** in the context of economic restructuring and globalization, by applying a two-level nested logit model to a multidimensional migration tabulation of the full records of the 1990 Taiwanese census. The main reason for focusing on the young adult labor force lies in the fact that young adults are at the most migratory ages of their life courses and hence have the greatest impact on redistributing the labor force and population in Taiwan. Since many migrations of those in the late teens and early 20s are largely due to the entries into and the exits from educational institutions and obligatory military service (only males), the young adult labor force in the study is limited to the 25-29 age group, defined as of 1990.

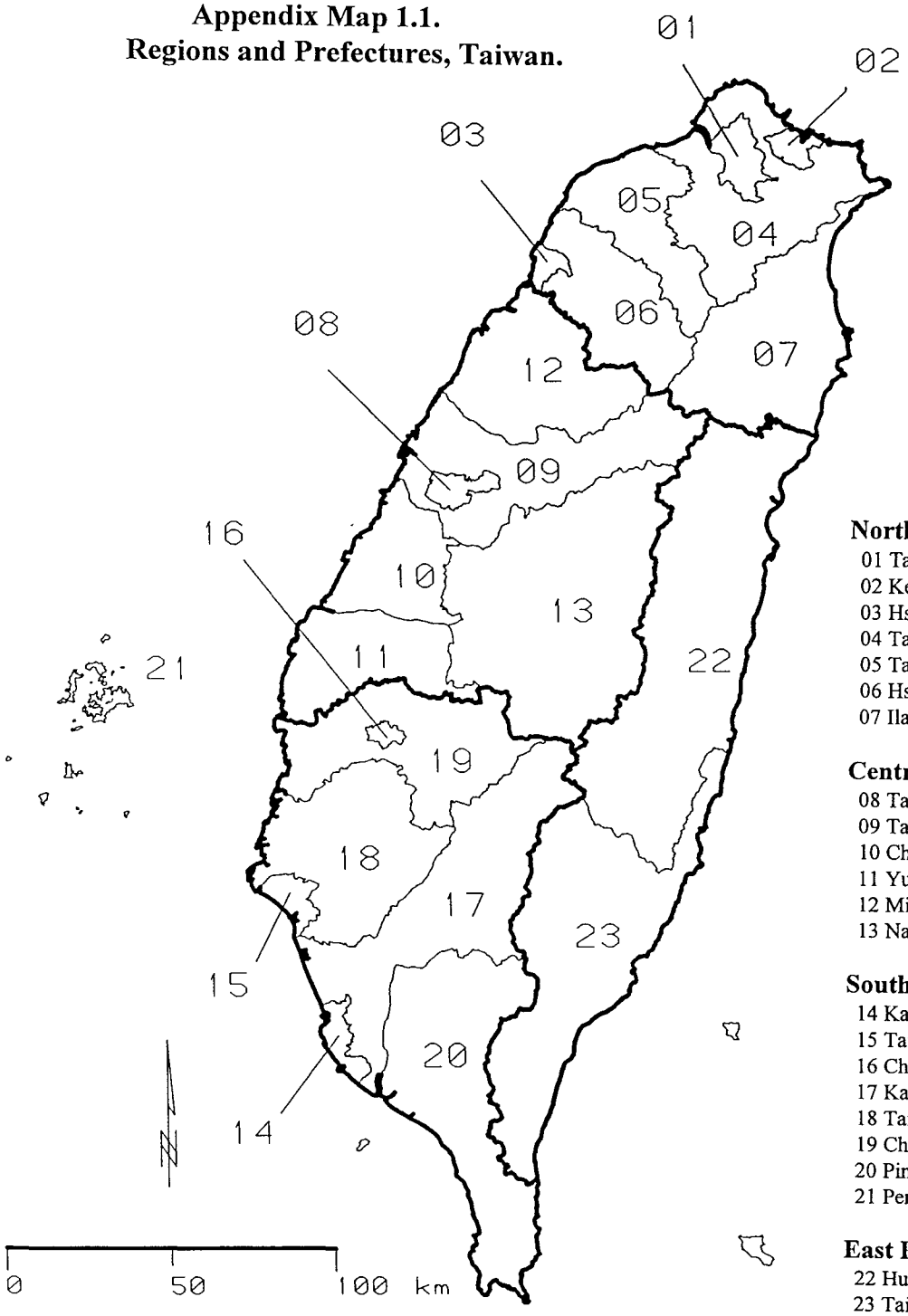
In conjunction with the research work of Chapter 5, ***Chapter 6*** focuses on the determinants of ***return and onward migrations of the young Taiwanese labor force*** in 1985-90, by applying a three-level nested logit model to the same migration data used in Chapter 5. The migration choice behaviors of the young non-native labor force are operationalized by the following sub-models: departure model at the top, return/onward model in the middle, and destination choice model of onward migration at the bottom. The chapter centers around the themes regarding the responsiveness to labor market forces, the effects of disappointment with the outcome of previous migration, and the effects of cultural

system on repeat labor migration behaviors. Since disappointments are more likely to result in return migrations, and onward migrations are more likely to be induced by the pursuits of newly available opportunities, the separation of repeat migrations into return and onward types is expected to yield a better understanding in migration behaviors.

Chapter 7 studies the determinants of ***fast repeat migration of the labor force*** in Taiwan, by applying a multinominal logit model to the aforementioned linked migration data. This chapter first offers a set of hypotheses inspired by previous North American studies during the past two decades and derived from the cultural context of Taiwan. Next, it turns to the examination on the validity of proposed hypotheses. The main objectives of this chapter are (1) to identify the determinants of job-related fast repeat migrations of individuals in the civilian labor force of Taiwan, and (2) to examine whether the effects of these determinants are largely consistent with the existing theories and with the findings of other empirical studies. In sharp contrast to the study of 5-year repeat migration in Chapter 6, this chapter provides different insights into the decision-making mechanism of repeat migration of the labor force in Taiwan.

Chapter 8 concludes by summarizing major findings of the thesis and suggests directions for further research.

Appendix Map 1.1.
Regions and Prefectures, Taiwan.



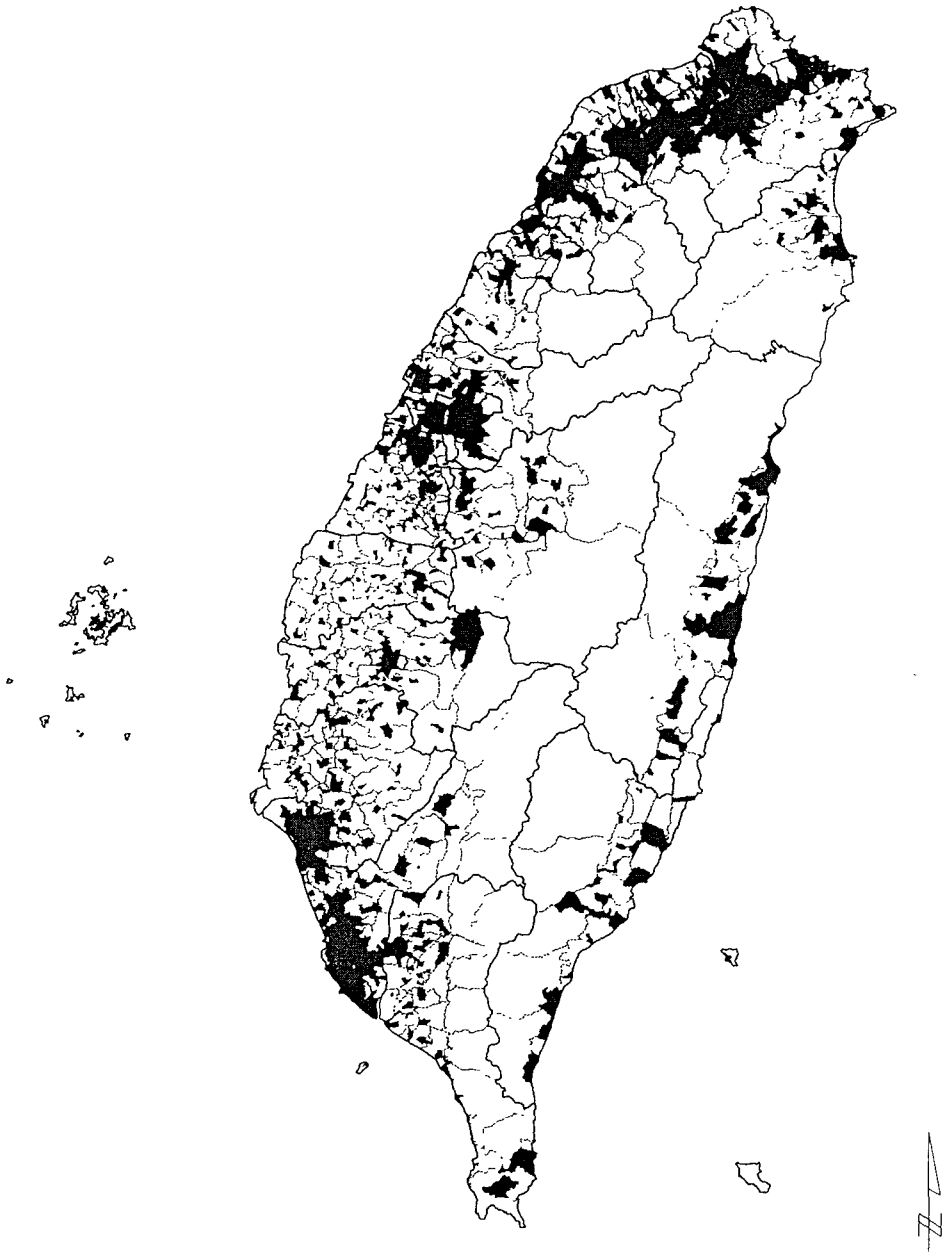
North Region
01 Taipei City
02 Keelung City
03 Hsinchu City
04 Taipei Hsien
05 Taoyuan Hsien
06 Hsinchu Hsien
07 Ilan Hsien

Central Region
08 Taichung City
09 Taichung Hsien
10 Changhwa Hsien
11 Yunlin Hsien
12 Miaoli Hsien
13 Nantou Hsien

South Region
14 Kaohsiung City
15 Tainan City
16 Chiayi City
17 Kaohsiung Hsien
18 Tainan Hsien
19 Chiayi Hsien
20 Pingtung Hsien
21 Penghu Hsien

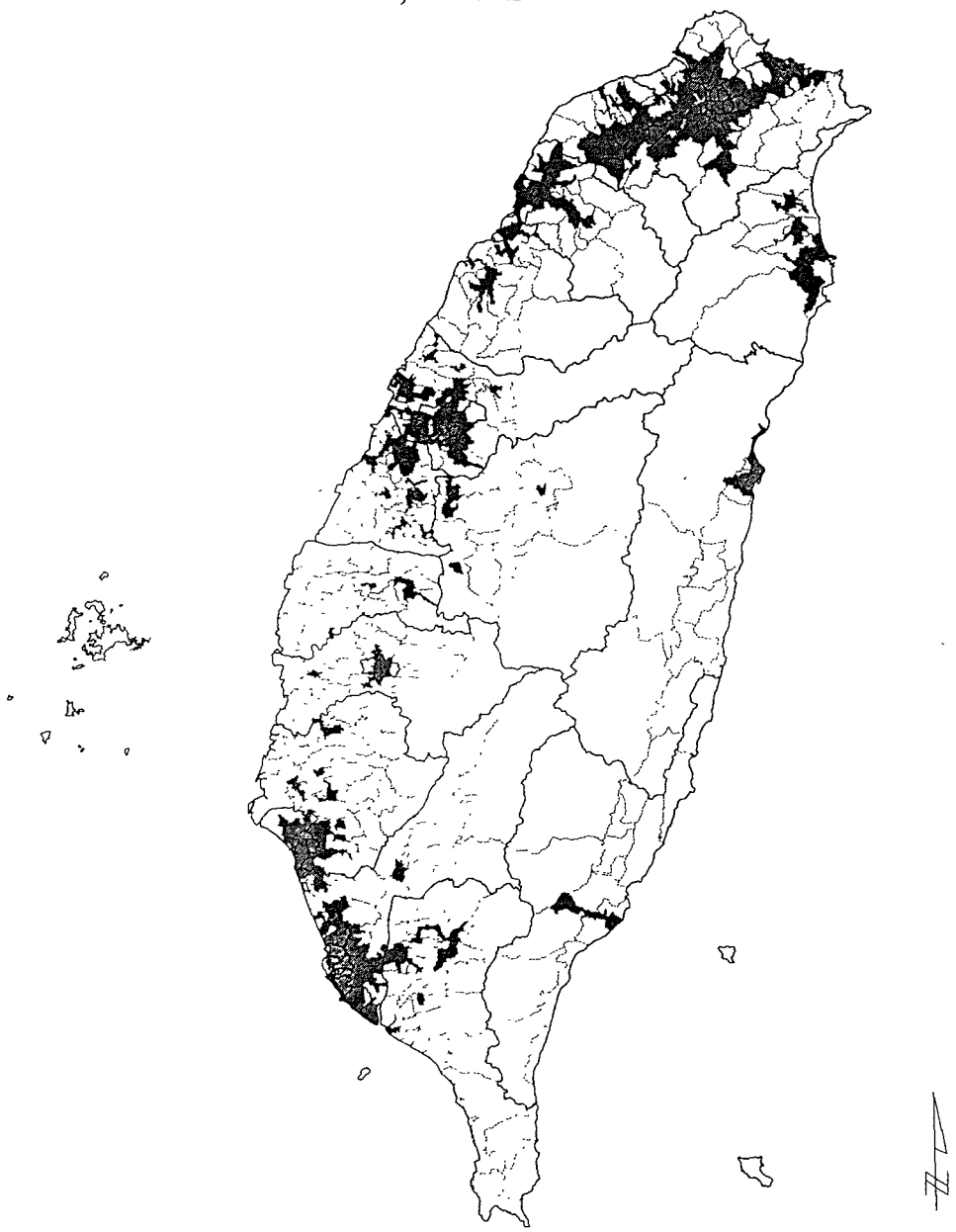
East Region
22 Hualien Hsien
23 Taitung Hsien

Appendix Map 1.2.
The 1992 Population Settlement System, Taiwan.



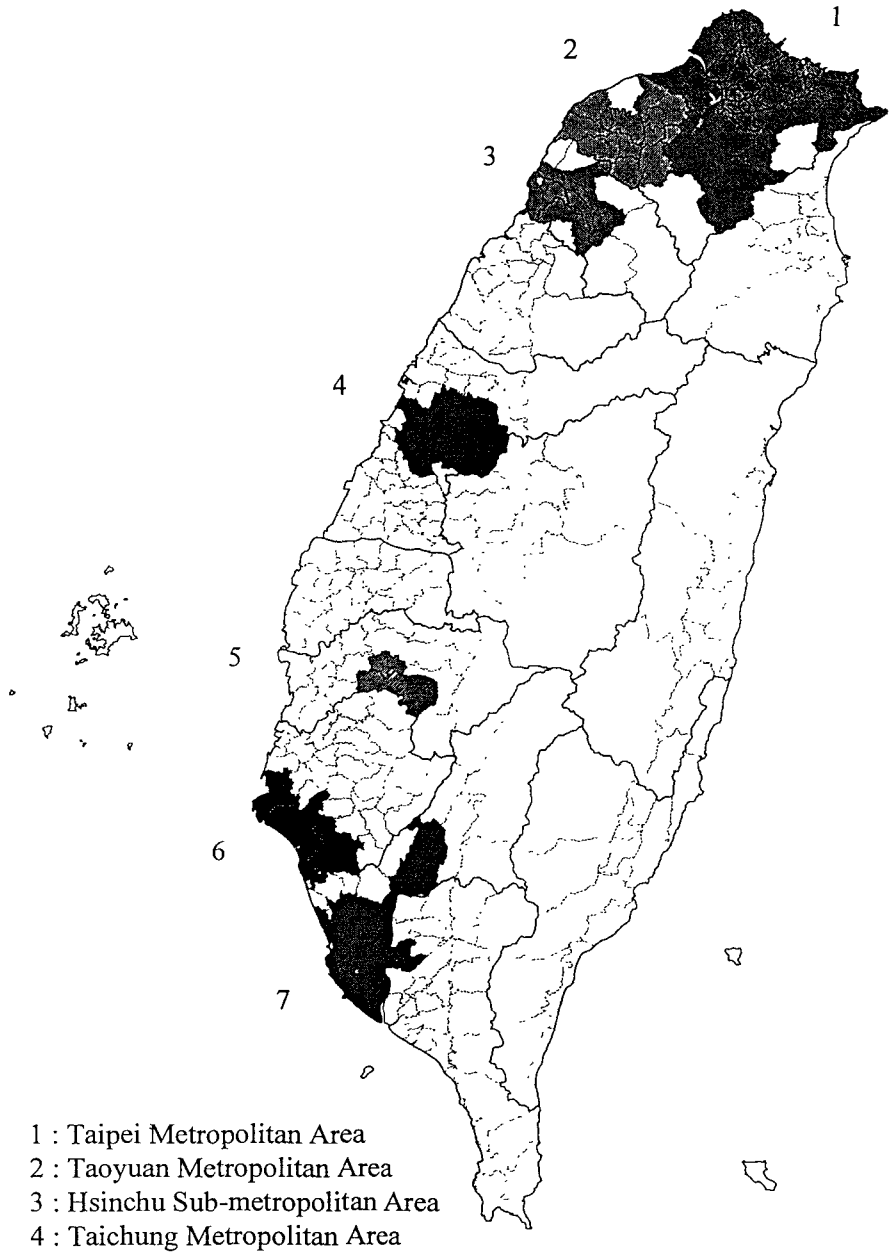
Note:
For the definition of population settlement system, see DGBAS(1993b).

Appendix Map 1.3.
The 1992 Urbanized Areas, Taiwan.



Note:
For the definition of urbanized area, see DGBAS(1993b).

Appendix Map 1.4.
The 1992 Metropolitan Areas, Taiwan.



1 : Taipei Metropolitan Area
2 : Taoyuan Metropolitan Area
3 : Hsinchu Sub-metropolitan Area
4 : Taichung Metropolitan Area
5 : Chiayi Sub-metropolitan Area
6 : Tainan Metropolitan Area
7 : Kaohsiung Metropolitan Area

Note:
For the definition of metropolitan area, see DGBAS(1993b).

Chapter 2

A Review of Migration Literature

2.1 Introduction

Study of migration aims at answering the questions about why, what, where, and how people migrate and at assessing the resulting demographic and socioeconomic impacts. Although Ravenstein (1889) formulated the so-called "laws of migration" from the data of 1881 British population census more than a century ago, there had been relatively little migration research designed to formulate general theories of migration and to use empirical data to test them until the mid-1960s, when Lee (1966) presented a ***push-pull framework*** by synthesizing findings in migration literature. This framework turned out to be more a general conceptualization than a theory aiming at explaining the underlying migration behavior and mechanism. Since then, many specific theories of migration have been formulated and tested.

Since the empirical work of this dissertation mostly involves labor migration, this review will focus primarily on ***the economic theories of migration***. In addition to identifying salient features of these theories, empirical findings, mostly Canadian and American cases, will be used to assess their validity. Note that it is inadequate to view the North American cases representing any universal generality of migration behaviors, because a variety of migration patterns tend to vary with countries due to institutional differences. Nevertheless, I hold a belief that the inherent behaviors of the human beings remain very similar regardless of the type of society and the level of development.

To examine the validity of a theory requires the process of modeling. A well-known type of migration models is the classical ***gravity model*** (Zipf 1946) and its generalization derived from the concept of entropy maximization, namely, ***the spatial interaction model*** (Wilson 1970). However, a better modeling methodology is based on the framework of ***discrete choice*** as well as its extension (McFadden 1974; Ben-Akiva and Lerman 1985; Kanaroglou et al. 1986; Train 1986). With the assumption that an individual aims at choosing an alternative with maximum utility from the choice set, this framework allows researchers to model the decision-making of migration at micro level and to explore the determinants of migration more precisely.

A main theme that will be pursued in a large part of this thesis is the dependence of current migration behavior on previous migration experiences. Thus, this chapter will also make a critical review on the findings that dealt with distinctive features of ***primary***, ***return*** and ***onward*** migrations.

This chapter is organized as follows. At first, four major schools of economic theories of migration are reviewed in Section 2.2, with an effort to contrast them and to compare the resulting policy implications. Section 2.3 reviews important findings on primary, return and onward migrations and their determinants and selectivity. Section 2.4 addresses the relationship between labor migration and market adjustment. Section 2.5 concludes this chapter.

2.2 Major Economic Theories of Migration

Major economic theories of migration can be grouped into the following four schools: (1) ***neoclassical economic theories***, including *wage differential theory*, *expected income*

theory, and *human capital theory*, (2) ***new economics of migration***, (3) ***dual labor market theory***, and (4) ***theory of world systems***. It is worthy of stressing that the four schools of migration theory can be applied to explain ***international migration***, but the theories of dual labor market and world systems are less relevant to ***internal migration***. In this section, they are reviewed sequentially as below.

2.2.1 Wage Differential Theory

Based on classical economic assumptions, wage differential theory views that migration is caused by regional wage differentials due to geographic differences in the supply of and demand for labor (Hicks 1932). If demand is held constant, a region with a relatively larger reserve of labor has a lower wage level, whereas a region with a smaller reserve of labor has a higher wage level. In response to the spatial wage differentials, labor will move from low- to high-wage regions, resulting in rising wage levels in the sending regions and declining wage levels in the receiving regions. In the end, this adjustment mechanism will reach an equilibrium at which regional wage differentials reflect only migration costs, and interregional transfers of labor are reduced to zero. Implicit in this theory is that migration is subject to the positive effect of destination wage and the negative effect of origin wage.

Numerous empirical studies since the 1960s (e.g. Lowry 1966; Courchene 1970) have provided a strong support for the positive effect of destination wage on migration but a weak support for (or even contradictions against) the negative effect of origin wage. However, later studies that used better formulated models have revealed that the inconclusive findings about the effect of origin wage were mainly due to the fact that earlier studies were unable (1) to separate the departure process from the destination choice process and (2) to control for the

strong effects of personal factors on the departure process. Thus, at least for the labor force and young adult population, the effects of origin and destination wages on migration specified in the wage differential theory are in general well supported by a bunch of real-world evidences.

The role of migration in reducing interregional wage differential appears to be well supported by the empirical data of the United States. The large South-to-North net migration in the United States was clearly accompanied by a sharp reduction in the North-South wage gap through most of the decades of the 20th century: the per capital income of the Southeast Region increased from 45% of the national average in 1900 to 97% in 1985 (Mills and Hamilton 1989, pp. 43). However, it is more difficult to observe this effect in Canada (Courchene 1994). It seems that the apparent failure of migration to reduce interregional wage differentials in Canada and other countries can be mainly attributed to the positive selectivity in migration and to government policies that interfere with labor market.

Wage differential theory is basically a macro theory that emphasizes the role of market. According to this theory, an efficient way of regulating migration flows is to influence labor market conditions in both sending and receiving regions. However, because of its unrealistic assumption that labor is homogeneous and fully employed, this theory fails to account for some phenomena such as (1) return migration and (2) the continued massive rural-to-urban migration in the developing countries in spite of the rising urban unemployment and underemployment.

2.2.2 Human Capital Theory

The most well-known micro neoclassical theory of migration is the human capital

theory, in which migration is viewed as an ***investment in human capital*** : an investment that has costs and renders returns (Sjaastad 1962). The costs of migration comprise (1) travel costs, (2) opportunity costs of foregone earnings between jobs, (3) job search costs, (4) information costs, and (5) non-monetary psychic costs associated with settling in an unfamiliar environment and losing old social ties. Returns from migration mainly come from two sources: (1) the monetary benefits arising from the income difference between destination and origin, and (2) the non-monetary benefits such as those arising from environmental and social amenity (e.g. milder winter and better schools for children).

Migration decision in human capital theory is based on a cost-benefit calculation so that a potential migrant will migrate only if the returns to migration outweigh the costs of migration. Mathematically, this comparison is based on:

$$NLR(0) = \int_0^n [P_{de}(t)Y_d(t) - P_{oe}(t)Y_o(t)]e^{-rt}dt - C(0) ;$$

where *NLR(0)* is the present net lifetime returns of migration; *t* is time; *n* is the length of time after migration; $P_{de}(t)$ and $P_{oe}(t)$ are the employment probability at destination and origin, respectively; $Y_d(t)$ and $Y_o(t)$ are the earning functions at destination and origin, respectively; *r* is discount rate; and *C(0)* is total moving costs. If *NLR(0)* is positive, then a potential migrant will migrate.

Classical human capital theory is more likely to have a stronger explanatory power than wage differential theory, because the former recognizes the effects of individual characteristics. For example, older people are less likely to migrate than the youth because they have a shorter life span to enjoy benefits of migration and their psychic costs may be

greater; education is expected to have a positive effect on the propensity of migration, because the more educated can process information more efficiently and are less subject to previous social ties than their less educated counterparts. Nevertheless, it is seen to be incapable of accounting for the decision of ***repeat migration*** (migration after an initial move). Such a problem arises mainly from an implicit assumption that migration decision is always correct: with perfect information and foresight, potential migrants will always correctly weigh the benefits and costs in deciding whether and where to migrate. Thus, it was emphasized by Da Vanzo (1981) that misinformation and lack of foresight are pervasive in the real world.

By incorporating the theory of job search, Yezer and Thurston (1976) extended the human capital theory to deal with the aforementioned problem. The main features of ***job search theory of migration*** include: (1) the recognition of the existence of a job search duration immediately after an initial migration, (2) the stress on the importance of job search costs, and (3) the acknowledgment that migration decision is not always correct. In its simplest form, job search theory of migration asserts that a potential migrant residing in region o will move to region d if the present value of migration from o to d is positive. The present value of migration, PV_{od} , is defined as

$$PV_{od} = \int_{t_s}^{T} W_d \, e^{-rt} dt - A_{od} - M_{od} - S_d(t_s) - \int_{0}^{T} W_o \, e^{-rt} dt \; ;$$

where t_s is job search duration; T is work time; W_o and W_d are respectively real origin wages and real destination wages; A_{od} represents the present value of the attractiveness differential

between o and d; M_{od} is moving costs; S_d is job search costs; and r represents discount rate. Migration is not likely to happen, unless the wage of at least one destination is greater than a threshold of the so-called ***minimum destination wages*** (i.e., a level of W_d such that PV_{od} is equal to zero, other things equal). A potential migrant prior to move will predetermine her/his ***goal wages*** and her/his ***reservation wages*** (i.e., minimum acceptance wages) at destination, with the goal wages being greater than the reservation wages.

The job search theory offers some insights into the selectivity of migration. For example, a pessimist tends to have lower goal wages due to underestimating destination wages, whereas an optimist tends to have higher goal wages by overestimating destination wages. Consequently, a pessimist is less likely to move than an optimist, because the former has a lower PV_{od}. Once a move happens, a pessimistic migrant tends to experience shorter job search than does an optimistic migrant, because the initial goal wages of the optimistic migrant tend to be higher than the real destination wages. To reduce the opportunity costs of foregone earnings, the optimistic migrant has to revise his goal wages downward toward reservation wages in order to take a job. If the revised goal wages still mismatch real destination wages, she/he must then consider making a repeat migration in search of job opportunities elsewhere, resulting in either an onward or a return migration.

Even in its extended form, human capital theory, however, is not without its shortcomings. For example, it is hard to formulate the cost-benefit calculation in empirical study. Also, implications derived from human capital theory are not as conclusive as those derived from expected income theory. For example, some rural development programs such as improving education and rural-urban transportation systems not only increase the benefits of rural areas but also reduce the monetary and psychic costs of migration. Since the relative

strength of the positive and negative effects on migration can not be easily assessed, human capital theory can not clearly tell us the extent to which such programs may have the effects of reducing rural out-migration (Rhoda 1983).

2.2.3 Expected Income Theory

Expected income theory was introduced by Todaro and his associates (1969, 1985) to explain rural-urban migration in the developing countries. It assumes that migration takes place in response to rural-urban ***expected income differentials*** rather than the differentials in actual earnings. A migrant evaluates various labor market opportunities available to her/him in both rural and urban sectors, and chooses the one which maximizes his lifetime expected gain from migration. Within this framework, the expected gain is measured by the difference between rural and urban income multiplied by the probability of obtaining an urban job.

This theory has three salient features. First, it recognizes that migration is ***not risk-free*** in the sense that a potential rural out-migrant must balance the probabilities of unemployment for a certain period of time against the favorable urban wage differential. Second, migration into urban areas with higher unemployment levels is not only possible, but also ***rational***. Even though present urban income falls short of present rural income, a potential migrant may decide to move when his expected lifetime urban income outweighs his rural lifetime income. Third, high urban unemployment levels are inevitable outcomes of the imbalance of economic opportunities between the urban and rural sectors in most developing countries. The imbalance is due to factors that are exogenous to the economic theory (e.g. the concentration of the political power in the capital city and the government's decision to maintain artificially a high urban wage level to preserve social order).

The expected income theory is very appealing in terms of providing policy implications for the developing countries. According to Todaro (1985), several implications can be generated from this theory. First, to reduce potential socioeconomic and political problems brought about by a heavy influx of rural out-migrants, it is necessary to reduce rural-urban wage gap. Second, urban job creation is not an efficient solution for the problem of urban unemployment, because further employment growth in urban sectors tends to attract more migrants into urban areas and reduce agricultural output in rural areas. Third, since the more educated are more capable of capturing a modern sector job than their less educated counterparts, indiscriminate educational expansion may lead to further rural out-migration. Forth, it is highly desirable (1) to minimize unnecessary economic incentives that will trigger rural out-migration and (2) to promote programs that focus on income generation and employment growth in the rural sectors.

Although the expected income theory is appealing, two assumptions held by the theory turn out to be inadequate. First, the theory assumes that migrants possess perfect information in the labor market (e.g. always being aware of the employment opportunity). Second, each migrant is assumed to be capable of "calculating" the expected incomes. Another shortcoming of the theory is that it fails to explain why rural out-migration rates are not the highest among the poorest regions. The school of new economics of migration provides remedies to these shortcomings.

2.2.4 New Economics of Migration

The new economics of migration has arisen to challenge many assumptions and conclusions of the neoclassical theories (Stark 1991). This perspective views that the decision unit of migration is ***household***; and that household members collaborate by sending

familial members out as a means of minimizing household risks and loosening market constraints. Central to this school are three considerations: (1) migration as means of ***risk avoidance/diversification***, (2) migration as ***mutually and voluntarily beneficial contract*** for the migrant and his familial members, and (3) migration as triggered by the household's feeling of ***relative deprivation***.

The views of risk avoidance/diversification and mutually beneficial contract considerations are inter-related. In a society where insurance markets are either incomplete or do not form, it is rational for a rural family to diversify its income portfolio by sending a family member to work in a city. From the remittances of the migrant, this diversification can reduce the risk of a disastrous reduction in familial income due to catastrophic events like a serious crop failure. In addition to diversifying familial income sources, a family may also be interested in adopting new but risky agricultural production technology in an attempt to increase family income. To minimize investment risk, the family behaves like an investor by sending out a migrant in the hope of obtaining future receipt of her/his remittances. To achieve this goal, the family agrees to bear migration costs and to insure the migrant against unemployment at the very risky initial stage of migration until she/he is fully established. In case the new technology fails, the economic survival of the family can rely on the remittances sent by out-migrated family member. Therefore, migration is viewed by this school as an insurance-type contract in which the family acts as an insurer and the migrant as an insuree at the first stage and their roles are reversed at the second stage.

To answer the question why migrants are willing to honor the contract by sending remittances, one possibility is the ***altruism*** of migrants. The other is the ***self interest*** of migrants due to the following considerations: (1) the aspiration to inherit her/his parents'

wealth, (2) the need to maintain a good relationship with his family members left behind, and (3) the need for help from the migrant's remaining family members to take care of and maintain her/his hometown investment (Lucas and Stark 1985; Stark and Lucas 1988). Amery and Anderson's (1995) Lebanese case study shows that altruism is more important than self-interest consideration of migrants in explaining the remittance behaviors.

In sharp contrast to the individual cost-benefit calculation of the neoclassical school, the school of new economics views migration as triggered by the household's feelings of ***relative deprivation***.[1] The feelings of relative deprivation stem from interpersonal income comparisons. A person will feel relatively deprived if her/his income falls short of the mean income of his ***reference group*** by a certain amount. For the families without out-migrants, the remittances received by the families with out-migrants help increase the income of reference group and hence aggravate their sense of relatively deprivation, which motivates them to start sending out some of their family members. Therefore, this theory suggests that rural-urban migration process, once started, tends to be ***self-perpetuating*** (Stark and Taylor 1989).

---

[1] Since the level of a person's feelings of relative deprivation is an ***increasing function*** of the proprtion of those whose incomes are above this person's, a simple measure for the feelings of relative deprivation of a person with a income level, y, can be formulated by

$$RD(y) = \int_{y}^{y_{max}} h[1-F(x)]\,dx \;;$$

where $RD(y)$ is the relative deprivation at the income level y; y_{max} is the upper limit income of the reference group; $F(x)$ is the cumulative income distribution of the reference group; and h is a monotonic increasing function with $h(0) = 0$ (Stark and Taylor 1989).

Policy implications derived from new economics of migration comprise two broad dimensions relevant to market effects and income effects. In terms of market effects, migration can be regulated not only by policies influencing labor markets, but also by those that have effects on insurance and capital markets. In terms of income effects, this school suggests that raising rural income level is not an effective way to reduce the level of rural out-migration and may even raise it, if the relatively poor households do not share the income gain. Therefore, in order to reduce rural out-migration, efforts should be focused on reducing inequalities such as narrowing down the variation in rural income distribution.

It is worth contrasting this school and the neoclassical school. First, the neoclassical theories stress the importance of absolute income effect in triggering migration, whereas the new economics of migration suggests that migration propensity will be higher in a community where the income distribution is very uneven. Second, the neoclassical school assumes that individual is the decision unit of migration and the decision-making is independent of other people; whereas the new economics of migration contends that migration is achieved through an interdependent decision-making by household members, and that the migrants have implicitly signed a beneficial insurance-type contract to each other. Third, the neoclassical school assumes that each additional dollar sent by migrants should increase household income by just one dollar. In the new economics of migration, remittances from migrants raise household income by more than the remittance value because part of the remittances will be utilized in investment. Fourth, the neoclassical school views migration as risk-taking, whereas the new economics of migration regards migration as risk aversion.

Despite its attractiveness, the new economics of migration still has its shortcomings.

First, like the neoclassical theories, this approach also assumes perfect information before migration, especially the assumption that every household knows the income distribution of its reference group. Second, the assumption of origin community as reference group may not be plausible. In the real world, a household's reference group probably is limited only to a tiny number of households. Third, the feelings of relative deprivation may not have the hypothesized monotonic positive effect on the migration propensity without controlling for the level of absolute income. For example, Stark and Taylor (1989) found that the measure of relative deprivation had a convex effect in a case study of a Mexican village. This was due to the fact that although the poorest are the most relatively deprived group, they may not out-migrate because of the constraint of migration costs. Therefore, neither the neoclassical theories nor the new economics of migration can give us fully satisfactory explanations of migration behaviors. Both schools in the end turn out to compensate for each other.

2.2.5 Dual Labor Market Theory

Dual labor market theory of migration was developed to explain international migration. This theory views that international migration is triggered by a permanent ***demand for immigrant labor*** that is inherent to the economic infrastructure of the developed countries. According to Piore (1979), international migration is unresponsive to the pushing factors of sending countries, rather, it is mainly caused by the pulling factors of receiving countries.

In an excellent review by Massey et al (1993), four fundamental characteristics of the developed countries are identified to be inherent to the demand for immigration. The first is ***structural inflation***, which refers to the inflation due to the necessity of adjusting wages proportionately throughout the job hierarchy in order to keep them consistent with social

expectations. To avoid this type of inflation, employers are forced to keep entry-level wages low by importing foreign labor. The second is ***status consciousness***. Occupational prestige and hierarchy are crucial considerations for native workers. Since there always exist the bottom-level jobs of any occupational hierarchy that the native-born workers feels ashamed of, the best solution for employers to fill these jobs is to recruit foreign laborers from the developing countries. The third is ***economic dualism***. In contrast to the fixed capital, labor is a variable factor of production. Because of the consideration of economic efficiency, the capital-intensive primary sector (stable and secure) is naturally filled by the skilled workers, whereas the labor-intensive secondary sector (unstable and insecure) needs only the low-skilled workers. To fulfill the demand in the secondary sector, employers turn to immigrant labor. The fourth is ***demographic change of labor supply***. Due to the increasing labor force participation of women as well as the lengthening of education years, the major entry-level labor has shrunk substantially over time for the developed countries. As a result, the imbalance between the demand for and the supply of entry-level workers produces the need for immigrant laborers.

In brief, the theory of dual labor market views that international migration of labor is primarily demand-driven in the developed countries and has little to do with the pushing factors of sending countries. As a result, in terms of regulating the volume of immigrants, this school tells us that "[g]*overnments are unlikely to influence international migration through policies that produce small changes in wages or employment rates; immigrants fill a demand for labor that is structurally built into modern, post-industrial economies, and influencing its demand requires changes in economic organization*" (Massey et al 1993).

2.2.6 World Systems Theory

Based mostly on the work of Wallerstein (1974), the school of world systems theory suggests that the onset of international migration is caused by ***the penetration of capitalist economy*** into peripheral societies in search of ***land***, ***raw materials***, ***labor***, and ***new consumer markets*** since the sixteenth century (Portes and Walton 1981; Sassen 1988). During the past, the expansion of capitalist economy was assisted by the colonial regimes, whereas today it is largely made by multinational firms. One outcome of the penetration of capitalist economic system is an increasing proportion of population in developing countries being incorporated into the system of world market economy.

As a consequence of ***economic globalization*** and the ***material and ideological links*** to places where capital originates, an increasing number of laborers in the developing countries who are displaced by the penetration of capitalistic economic system migrate abroad, although many of them choose to migrate to cities, leading to massive rural-to-urban migration and rapid urbanization. The material and ideological links not only help promote the movement of goods, capital, information, and ideology, but also have a positive effect on the propensity of international out-migration from the developing countries, because they function to reduce international migration costs. As a result, international migration of labor in general follows the international capital flows in the opposite direction.

Economic globalization has also resulted in the emergence of the so-called ***global cities*** like New York, Toronto, London, Paris, and Tokyo during the recent decades, because the global economy is managed within these few cities where finance and banking services and high-tech industry tend to be concentrated (Sassen 1988). Meanwhile, the shift of traditional industries toward high-tech ones and the expansion of service sector also help create a segmented labor market in these cities, leading to a strong demand for the workforce

at both the upper and lower levels of the occupational hierarchy, with relatively weak demand in the middle level. Since the less educated natives are less interested in taking the low-end jobs, the need for services to keep the higher-end sector functioning in these cities brings about the strong demand for immigrant laborers.

In sharp contrast to other schools of migration, world systems theory views that international migration of labor stems from economic globalization, and that income and employment differentials between countries have little effect on generating international migration. An important implication of this theory is that an effective way to influence international immigration is to regulate overseas investment activities, although such measure is impracticable for a liberal economic system (Massey et al 1993).

2.3 Type of Migration, Determinants and Selectivity

2.3.1 Type of Migration: Primary, Return, and Onward Migration

Abundant evidences from a variety of countries have demonstrated that non-natives are much more footloose than natives (Morrison 1971; Miller 1977; Long 1988; Liaw and Ledent 1988; Newbold and Liaw 1990; Rogers and Belanger 1990). The difference in migration propensities between natives and non-natives is partly due to that "*the differential migration propensities between natives and non-natives are directly related to a fact that migration "decision thresholds are initially high for persons who have never moved in their adult lives (Morrison 1969). Once a move has been made, the experience may foster a* ***learning process*** *that blunts subsequent inertia*" (Morrison 1971, pp. 179). Therefore, if migration is a learning process, it becomes very important to distinguish whether an individual possesses the experience of migration.

One way to distinguish whether an individual ever migrated is based on ***the nativity status*** (native vis-a-vis non-native). Based on the nativity status, migration can be dichotomized into ***primary migration*** (migration of the native-born people) and ***repeat migration*** (migration of the non-native people). Also, repeat migration can be divided into ***return migration*** (migration of non-natives who move back to their places of birth or previous residence) and ***onward migration*** (migration of non-natives to a place other than their places of birth or previous residence). Because the decision process of primary migrant is relatively simple, substantial attention has been paid to the study of repeat migration in recent migration literature.

In general, explanations for the decision-making mechanism of repeat migration fall into two broad classes: ***the hypothesis of chronicity*** (Morrison 1971) and ***the job search theory of migration*** (Yezer and Thurston 1976), although they overlap to some extent. The hypothesis of chronicity views migration as a sort of "learning-by-doing" process through which past migration experience has an effect of reducing ***information costs***. Therefore, previous migration experience tends to foster migration chronicity, which in turn has the effect of triggering a repeat migration (Kau and Sirmans 1977; Da Vanzo 1981 and 1983; Da Vanzo and Morrison 1981). By contrast, the job search theory of migration contends that because of imperfect information and/or lack of foresight prior to an initial move, migration outcome might fall short of expectation (e.g. expected income gains), leading to the generation of ***disappointment***. In order to "correct" previous move, repeat migration may be triggered (Vanderkamp 1972; Yezer and Thurston 1976; Allen 1979; Schlottmann and Herzog 1981; Herzog and Schlottmann 1983; Grant and Vanderkamp 1985 and 1986).

It has long been recognized in the literature that migration is a highly selective

process (Myrdal 1957; Kuznets 1979). For example, without controlling for the type of migration, migration is selective of the young, the single, and the more educated in general. However, the selectivity mechanism becomes somewhat different with respect to each type of migration. Although primary migration tends to be more similar to onward migration than to return migration, the personal characteristics of primary migrants are not as complex and diversified as those of their experienced non-native counterparts (Long 1988). Also, it was noted by Morrison and Da Vanzo (1986) that ***fast returnees*** tend to be the less educated, recently unemployed and discouraged, and less inclined to plan ahead and take migration risk again, whereas rapid onward migrants appear to be highly educated and are more likely to plan ahead. Therefore, the sharp contrast between the behaviors of fast return and onward migration is particularly noteworthy.

2.3.2 Determinants and Selectivity of Migration

Migration determinants comprise two broad categories: ***personal characteristics*** and ***ecological variables***. Personal characteristics consist of an individual's demographic features (e.g. sex, age, marital status), human capital (e.g. education) and socioeconomic status (e.g. industry, occupation, employment status, and status of worker). Ecological variables refer to place attributes that may include not only a place's socioeconomic situations (e.g. incomes, employment conditions, population size, and cultural similarity) but also the factors such as its physical environments (e.g. weather conditions, environmental amenity) and the relative location.

When it comes to the effect of demographic factors, ***sex*** is an important factor for migration study. However, mostly because of the societal and cultural differences, findings on the patterns of sex selectivity seem to vary from one setting to another. By contrast, the

patterns of migration selectivity by ***marital status*** and ***age*** turn out to be clearer, because these factors tend to be related to the various stages of an individual's life cycle. For example, the bulk of evidences suggests (1) that the single are very footloose because they have less amount of location-specific capital, and (2) that any change in marital status often produces the need for migration (Long 1988).

To show the relationship between migration and the events of life cycle, the most revealing is the so-called ***migration schedule*** (i.e. pattern of age-specific migration rates). In ***North America***, the typical form of migration schedule includes (1) a sharp decline from a high level in the early childhood to a low level in the early teens, (2) a sharp upturn in the late teens that peaks in the early 20s, (3) a sharp decline in the late 20s toward a persistent low level between the late 40s and the late 50s, (4) a minor retirement peak in the 60s, and (5) another slight increase beyond the mid-70s(Liaw and Nagnur 1985; Rogers 1979 and 1988). In the United States, primary and onward interstate migration schedules have a clear retirement migration peak, whereas return interstate migration schedule does not (Long, 1988).

As indicated above, information-related factors are of the major determinants for repeat migration. Level of ***education*** undoubtedly is the most important personal attribute reflecting an individual's information-processing ability. Theoretically, since the field and quality of information tend to increase with educational attainment, the better educated are less likely to be disappointed after an initial move and are more aware of opportunities elsewhere than are the less educated. Thus, when repeat migration is triggered, it is expected that education should have a positive effect for onward migration and a negative effect for return migration, respectively.

Although empirical findings support the positive effect of education for onward migration, ***educational selectivity for return migration turns out to be ambiguous***.[2] Using the longitudinal files of PSID (Panel Survey of Income Dynamics), Da Vanzo (1983) and Morrison and Da Vanzo (1986) find that rapid return migration is selective of the less educated as opposed to onward migration. However, North American census data show that educational selectivity of return migration lacks any clear pattern, although the selectivity associated with onward migration exhibits a clear and strong positive pattern (Miller 1977; Long 1988; Newbold and Liaw 1994).

Another important information-related determinant of repeat migration is the level of an individual's past ***migration experience***. A good surrogate for the level of migration experience is the ***number of previous moves***, which is expected to have a positive effect on the likelihood of making repeat migration, because it is negatively related to the information costs of migration for a given potential migrant. Although empirical findings confirm its positive effect on the propensity of making repeat migration (Morrison 1971; Da Vanzo 1981 and 1983), its separate effects on return and onward migrations remain inconclusive. For example, Morrison (1971) suggests that its effect is limited solely to onward migration, because the familiarity with "home" region does not depend on the migrant's level of education; by contrast, Grant and Vanderkamp (1986) contend that the effect of the number of previous moves is positive on onward migration and negative on return migration, implying that its net effect on the propensity of repeat migration is unclear.

The so-called ***location-specific capital*** (e.g. house ownership, job seniority, close

---

[2] This problem will be clarified in the conclusion chapter of the thesis.

friendships and kinships) is also a very crucial determinant of migration, because it acts as the socioeconomic ties to a certain locality. Therefore, location-specific capital of current place of residence is expected to have an effect of causing a person (either native or non-native) to stay put, whereas location-specific capital that a migrant left behind in the "home" region tends to pull her/him back. Like other capitals, location-specific capital left behind will also depreciate with time. A good surrogate for location-specific capital in the empirical study is the ***duration of residence***. Regarding its effect on repeat migration, Da Vanzo (1981) and Da Vanzo and Morrison (1981) find that, with the duration of ***current*** residence being controlled, the duration of ***previous*** residence has a positive effect on return migration and a negative effect on onward migration, respectively.

Migration has long been found to be strongly subject to the so-called ***distance decay effect***, mainly because distance is directly related to the costs of migration and the amount of intervening opportunities (Miller 1972; Schwartz 1973). For the sake of clarity, distance effect must be distinguished in two different contexts: (1) ***effect of distance to a potential destination*** and (2) ***effect of previous migration distance on the propensity of making repeat migration***. First, with respect to the effect of distance to destination, it is reasonable to expect that the distance decay effect is very important on non-return (primary or onward) migration but becomes less significant or even insignificant on return migration because the familiarity with the "home" region and the help from relatives/friends left behind tend to reduce the information constraint of non-natives. Second, with respect to the effect of previous migration distance, its effect on repeat migration is expected to be positive, because the longer the previous move the greater the probability of disappointment (Grant and Vanderkamp 1985). Although empirical studies support this relationship, ***its separate effects***

on return and onward migrations also turned out to be inconclusive (Da Vanzo 1976; Herzog and Schlottmann 1982; Grant and Vanderkamp 1985 and 1986; Newbold and Liaw 1994 and 1995).[3]

Regarding the differential impacts of ***labor market variables*** on different types of migration, findings from Canada indicate that return migrants are less sensitive to the effects of labor market variables than primary and onward migrants. However, the behaviors of return migrants remain economically rational, and return migration can not be simply viewed as the migration in the "wrong direction" (Newbold and Liaw 1994 and 1995). More detailed discussions about the importance of economic ecological variables are presented in the subsequent section.

2.4 Migration and Market Adjustment

From the economic viewpoint, labor migration is an adjustment mechanism of labor market through which human resources are transferred to areas with a greater demand for labor. It is reasonable to expect, for example, (1) that labor tends to migrate from a region with a low wage level, a low employment growth rate, and a high unemployment rate to a region with a high wage level, a high employment growth rate, and a low unemployment rate; and (2) that migration tends to reduce or eliminate interregional economic disparities. However, many real-world cases suggest that the process of migration is not necessarily responsive to the market forces and the outcome of migration on many occasions even tends to aggravate rather than lessen the spatial economic disparities. This section assesses these relationships, with particular attention to (1) the apparent inability of migration to reduce

---

[3] An explanation will be offered in the conclusion chapter of the thesis, based on findings of Chapter 6 and 7.

interregional economic disparities and (2) some confusing empirical findings about the effect of unemployment level on migration.

In general, labor migration is unlikely to be economically efficient due to the constraints of ***non-economic factors***. For example, as suggested by the human capital theory, ***psychic costs*** have an effect of reducing potential migrants' response to the spatial economic opportunities (Sjaastad 1962). According to this view, regional income differential will persist because it reflects the aggregate level of migration psychic costs, although migration has an effect of reducing spatial income inequality. As reviewed above, ***current location-specific capital*** proves very crucial in decreasing the importance of market forces. Moreover, the general preference of residing in a familiar ***cultural environment*** also plays a crucial role. Therefore, non-economic factors, to a certain extent, contribute to the inability of labor migration in reducing the spatial economic disparities.

It is important to note that the effects of some economic factors may sometimes turn out to be perplexing. The most noteworthy ones are the effects of income and unemployment. With respect to the income effect, the effect of origin income level in reducing out-migration propensity tends to be relatively weak. According to ***the relative deprivation*** approach of the new economics of migration, the level of origin income need not to be a sufficient condition in retarding out-migration. Rather, the role of relative income may be more important than absolute income in accounting for out-migration (Stark and Taylor 1989; Stark 1991). On the other hand, there is not much doubt on the strong magnetic effect of high destination income level produced by ***economies of agglomeration***. Since economies of agglomeration are only seen within a few places, migration is unlikely to reduce the spatial economic disparities.

In terms of the effect of ***regional unemployment***, it is reasonable to expect that regional unemployment has a positive effect on out-migration and a discouraging effect on in-migration. However, empirical studies suggest that the influence of spatial variation in unemployment is ***ineffective on out-migration***, leading to a famous note by Greenwood (1975) that "*one of the most perplexing problems confronting migration scholars is the lack of significance of local unemployment rates in explaining migration*". For example, Van Dijk et al.(1989) find that high area unemployment rates significantly increase out-migration in the US but decrease in the Netherlands, and are unresponsive in Britain; in Canada, Anderson and Papageorgiou (1994) find unemployment rates have no significant effect on departure propensity, whereas Liaw(1990) finds unemployment has a negative effect on the out-migration of non-student potential migrants. Explanations for these inconclusive findings are generally attributed to ***the institutional dissimilarities*** (e.g., the differences in unemployment insurance programs). By contrast, it is commonly found that the influence of area unemployment rates is ***effective on in-migration***. For example, Liaw(1990), and Newbold and Liaw(1994 and 1995) find that the provincial unemployment level of Canada has the expected discouraging effect on the destination choice propensity in Canada.

With respect to the links between ***personal employment status*** and migration, the unemployed are expected to be more mobile than are the employed, because the former have higher ***opportunity costs*** of not moving and are less subject to ***the job-specific capital*** than the latter. Empirical evidences out of a variety of countries have provided unambiguous support in this regard (e.g. Da Vanzo 1978; Da Vanzo and Morrison 1981; Herzog and Schlottmann 1982 and 1983; Grant and Vanderkamp 1985; DGBAS 1981-1990, 1994). However, it is important to note that the employed who are ***dissatisfied*** with their current

jobs are also very migratory (Da Vanzo 1978; Da Vanzo and Morrison 1981). Therefore, migration turns out to be efficient from the micro viewpoint.

The inconclusive effect of regional unemployment seems to contradict findings from the micro perspectives. This perplexing phenomenon mainly stems from the fact that regional unemployment does not have a ***homogeneous effect*** on all potential migrants. Rather, its effect is mainly limited to the unemployed. With personal employment status being properly controlled, empirical findings do show the push effect of regional unemployment. For examples, Da Vanzo(1978) finds that regional unemployment rates do trigger out-migration of unemployed household heads; Herzog and Schlottmann (1984) find that the propensity of out-migration for the male construction workers increases with metropolitan area unemployment rates; Newbold and Liaw(1994 and 1995) find that although the Canadian provincial unemployment level seems not to deter return migration, it does have a negative effect on the destination choice propensity of onward migration.

In sharp contrast to the fact that the effect of regional unemployment is mainly limited to the unemployed, ***the level of available employment opportunities*** (e.g. employment growth) has been demonstrated by many studies to have a broader effect on a larger proportion of the labor force, either the employed or unemployed. For example, empirical evidences show (1) that potential migrants are relatively more subject to the retention effect of origin employment growth than to the push effect of origin unemployment level, and (2) that the migrants are more sensitive to the job opportunities than to the unemployment level of destination (e.g. Greenwood, Hunt, and McDowell 1986; Liaw 1990; Bartik 1993 and 1994; Anderson and Papageorgiou 1994; Newbold and Liaw 1994 and 1995; Liaw and Frey 1996). As a result, it seems that not only does the availability of

economic opportunities have the effect of reducing unemployment duration of the unemployed, but it also functions to reduce the retention effect of job-specific capital, allowing the employed to seek better economic opportunity elsewhere.

Also, the level of migration has long been confirmed to fluctuate effectively with ***economic cycle***. Mostly because of changes in the costs of and returns from migration, the level of migration is characterized by a downturn during a bust period vis-a-vis an uprise in a booming period (Greenwood, Hunt, and McDowell 1986; Haurin and Haurin 1988). In addition to the migration level, another consensus in migration literature is that the quality of migrants turns out to be relatively lower during a recession as opposed to that in an economic boom. To account for the effect of business cycle on the level of migration quality, Vanderkamp (1971) and Da Vanzo (1976) suggest that the declining migration quality during recession is primarily due to a substantial ***increase*** in the "lower quality" return migrants, whereas Newbold and Liaw (1994) find that it is due to a substantial ***decline*** in the number of the "doubly selected" onward migrants, and that the educational selectivity in return migration is rather insensitive to economic cycle.

The efficiency of labor migration may be intervened by institutional arrangements like ***unemployment insurance*** and ***labor union***. The perceived negative effect of unemployment insurance programs on the migration propensity is primarily due to the fact that unemployment insurance tends to increase reservation wages of job searchers and thus increases unemployment duration of the unemployed. In addition, it also had the effect of reducing the costs of being the unemployed and hence decreasing the propensity of making migration. For example, Da Vanzo (1978) finds a negative effect of non-wage income on the migration propensity of the unemployed; Liaw(1990) attributes the negative effect of

Canadian regional unemployment on the departure propensity to the generosity of Canadian unemployment insurance. As a result, reducing unnecessary unemployment benefits may promote the efficiency of human resource reallocation in the labor market.

Nevertheless, Goss and Paul (1990) contend that the role of unemployment insurance in affecting migration efficiency is indeterminate, because it also has the effect of financing migration. By controlling for the conditions of job termination and the availability of unemployment insurance benefits, they find that unemployment insurance benefits exhibit two opposite effects. First, unemployment benefits increase migration propensity for those who voluntarily separated from employment, because they tend to make use of insurance benefits for job searching. Second, receipt of unemployment compensation decreases migration propensity of the involuntarily unemployed, because they tend to wait for job call from their prior employees. As a result, they conclude that since a significant proportion of the unemployed is involuntarily unemployed in economic recession periods, unemployment compensation serves to retard migration and thus reduces labor market efficiency.

2.5 Conclusion

This chapter has reviewed the existing economic theories of migration: the neoclassical theories, the new economics of migration, the theory of dual labor market, and the theory of world systems. As noted by Massey et al (1993 and 1994), each school of migration theories has its own advantages and shortcomings, and they function to be ***mutually complementary*** to each other in migration study.

For the school of the neoclassical theories, the macro view emphasizes the importance of market forces (e.g., regional income differential and spatial employment

conditions), while the micro perspective stresses how a potential migrant aims at maximizing her/his lifetime income based on the cost-benefit calculation, and considers migration as an outcome of self-interested individual decision. By contrast, the new economics of migration considers migration in a framework of familial decision that aims at minimizing risks to family income and at overcoming capital constraints on family production. The dual labor market theory suggests that international migration is inherent to the economic structure of developed countries that produces the demand for immigrant labor, while the theory of world systems posits that the emigration of non-capitalist societies is due to the penetration of capitalist economy.

This review also has distinguished the three types of migration (primary, return, and onward), the determinants and selectivity of migration, and the relationship between migration and market adjustment. One goal of migration research is to assess the macro consequence and impact of migration on a population system, and to provide sound policy implications. Because any macro outcome of migration is the aggregate result of individual migration decisions, it turns out to be more appropriate to start the study on migration process from the micro than from the macro level.

In the end, it is important to note that although it is unlikely to be very comprehensive, the review work of this chapter is closely related to the research contents of subsequent chapters. Based on macro time series data and previous research, ***Chapter 3*** not only explores the relation between migration and socioeconomic developments in Taiwan since the seventeenth century, but also enables us to see the aforementioned economic theories of migration in explaining migration in Taiwan and the relationship between migration and market adjustment within a broader temporal context. ***Chapter 4*** focuses on

the general situation of labor migration in Taiwan in 1985-90 by stressing the importance of changing economic structure and the impact of migration on the spatial variations in the quality and quantity of human resources. Based on the micro discrete choice framework, ***Chapter 5 and 6*** study the behaviors and determinants of primary and repeat (return and onward) migrations of the young labor force in Taiwan during 1985-90. In light of the fact that fast repeat migration tends to differ substantially from non-fast repeat migration, ***Chapter 7*** studies the case of fast repeat migration based on the linked migration data set.

Chapter 3

Migration , Settlement System, and Socioeconomic Development in Taiwan: 1600-1990

3.1 Introduction

Located off the southeast coast of China and in the oceans between the Philippines and Japan, Taiwan has been subject to the influences of changing global circumstances and geopolitics in the Far East at different stages of its development. Since the early 17th century, the development of Taiwan up to the 1940s, including migration and evolution of its settlement system, had been largely shaped by the external powers of the Dutch traders and the Empires of China and Japan which directly or indirectly affected the situations of immigration into Taiwan. Their development policies, together with the constraint of physical environment of Taiwan, were also important to account for internal migration and the evolution of settlement system in Taiwan.

After the World War II, the development of Taiwan became more dependent on internal forces, although external influences can not be ignored. Policies introduced by its own government, such as those on agricultural land reforms, development of light and heavy industries, promotion of export, and the switch to knowledge-intensive industries, not only contributed to the success in its economic development, but also had significant effects on the migration process and the evolution of its settlement system.

The purpose of this chapter is to study how migration and the settlement system of Taiwan evolved since the 17th century when Taiwan started to be transformed into a land of immigrants. Such a historical study is helpful for achieving deeper insights into the links between migration and the socioeconomic development, because what happens in a period of time depends to a large extent on the constraints and legacy of previous periods, and because the importance of a newly emerged factor can be better assessed in a historical perspective.

According to the major external and internal socioeconomic and political changes, this historical study is divided into the following periods: (1) the era of immigration and frontier-type society (1600-1894); (2) the era of the Japanese administration and infrastructural development (1895-1945); (3) the era of chaotic times and retrogression (1946-1950); (4) the era of rehabilitation (1951-1960); (5) the era of economic takeoff (1961-1973); (6) the era of industrial restructuring (1974-1984); and (7) the era of development toward a pluralistic and open system (1985-90).

3.2 The Era of Immigration and Frontier-type Society: 1600-1894

Although there had been a community of mostly fishermen, merchants, pirates and other risk-takers on the Pescadore Islands (Penghu nowadays) as early as the twelfth century, the main island of Taiwan remained to be an unattractive place for immigration for many centuries, because her aborigines would ruthlessly knock down any intruders (Chen 1979, pp. 23-27; Hsu 1980, pp. 41-42). As for the population of Taiwan's aborigines, they were a diverse collection of Malayo-Polynesian people, engaging in hunting, gathering, and less advanced agricultural activities. Although it is known that they inhabited both the lowlands

and highlands, the actual size of population was not clear (Hsu 1980, pp.12-18).

Reacting to the harassments and forays of the Japanese pirates along the southeast coasts of China in the late fourteenth century, the Chinese Ming Dynasty implemented a policy of extensive "Sea Ban", forcing seacoast inhabitants to move inward. Lasting for nearly two hundred years, this policy had an effect of retaining the status of Taiwan as a virgin land for Chinese immigration. Since the Portuguese sailors first saw it in 1557, yelling "Ilha ***Formosa***" (beautiful island), Taiwan began drawing the attention of the emerging Western maritime powers. However, it was not until the Dutch era (1624-1662) that the island started becoming an open land for Chinese immigrants (Hsu 1980, pp. 42-52).

In a sharp contrast to the long history of the Chinese Empire showing no interest in Taiwan, the Western maritime powers soon recognized the importance of Taiwan's strategic location amid the Japan-Southeast Asia trade route (Hsu, pp. 42-46). By the early seventeenth century, in a hope of competing with its Spanish and Portuguese rivals in the Far East for trade, the Dutch East Indies Company (headquartered in present-day Jakarta) established a base in a place of southern Taiwan aboriginally pronounced as ***Taioan*** (located near today's Tainan[1] City) in 1624. In order to export Taiwan's bountiful products like sugar and deerskins, the Dutch authorities encouraged agricultural development and actively recruited laborers, mostly single males, from Southeast China (mostly Fukien area) to fulfill the growing demand for manpower (Chen 1979, pp. 27-30).

The importance of the Dutch colonization in southern Taiwan was twofold. The first was the formation of an ***immigration "port of entry"*** in the Tainan area, which had a

---

[1] The word "Tainan" in Taiwanese stands for "the southern part of Taiwan".

function of providing a safe base for immigrants and thus allowed the risk-takers to explore into inlands. The other was the introduction of ***agricultural economy*** which had an effect of gradually transforming the tribal society into an agrarian society (Chen 1979, pp. 25-33; Hsu 1980, pp. 92-98). By the end of the Dutch era, the population of Taiwan, mostly concentrated around the southern Tainan area, amounted to about 100,000 (Chen 1979, pp. 18). In short, with Taioan (the Tainan area) as the hub of development, the Dutch colonization marked the onset of an immigration era in Taiwan.

As the Ming Dynasty was overthrown by the Manchu Empire (thereafter the Ching Dynasty) on China, the Dutch colonial power on Taiwan was replaced by the regime of the Chengs moving from ***southern Fukien*** of southeastern China. One outcome of the establishment of the Chengs on Taiwan was the introduction of another wave of Chinese immigrants. More importantly, the immigrant population, though mostly still concentrated around the Tainan area, began spreading northward for cultivation, mainly through the assistance of an extensive system of military colonization (Hsu 1980, pp. 108-110). Consequently, the population dispersed further to the central and southern plains, with some establishments of developmental bases in the northern territory. By the end of the Chengs period (1662-1683), the population had doubled to an amount of around 200,000 persons (Chen 1979, pp. 18).

Although the replacement of the Chengs regime in 1683 by Manchu's Ching Dynasty formerly brought Taiwan into Chinese territory in history, intention of the Ching Dynasty in managing this land actually was very limited, because the island was still viewed as marginal. Moreover, in fear of Taiwan becoming a rebellious base, the authorities even banned emigration from China to Taiwan (Chen 1979, pp. 379). However, the flows of

Chinese immigrants to Taiwan (mostly from ***southern Fukien*** and partly from ***Canton*** of China) in the hope of acquiring their own land in time had never been halted by this policy. More ironically, the eighteenth century even turned out to be a ***"golden era" of immigration*** in Taiwan's history (Hsu 1980, pp. 131-134).

During the eighteenth century, in conjunction with the heavy influx of immigrant peasants was the growing importance of agriculture. In addition to sugar and deerskins, ***rice*** became another important export commodity of Taiwan, which was used in exchange for other goods with China. In the meantime, the ***tenant-landlord land tenure system*** was gradually being formed. Numerous immigrants of this period started as tenants, whereas the landlords (earlier immigrants) were mostly absent from the land, because most of them resided in urban areas or on the Chinese mainland (Hsu 1980, pp. 195).

As an inevitable consequence of the growing agricultural economy and the strong desire of immigrant tenant farmers to acquire their own land, countless bloody confrontations between the aborigines and the frontier peasants occurred. Since the very beginning of the eighteenth century, the aboriginal population gradually became disadvantaged in the face of the bulk of immigrants. One resulting outcome was the mutual ***assimilation*** between them through the process of, for example, marriage. However, those defeated and deprived aborigines who refused to assimilate were gradually forced to ***retreat*** into the mountainous inlands. In the hope of reducing bloody conflicts between the settlers and aborigines, the authorities even implemented a "Ban on Mountain Cultivation". Nevertheless, it barely had the effect of halting the aggressive cultivators coveting the aborigines' lands.

In light of the heavy influx of Chinese immigrants, it is worthy of highlighting the

selectivity of immigration, because it helped shape the societal characteristics. Naturally, immigration to Taiwan at the frontier stage was selective of the optimists and aggressive risk-takers, who were mostly single males and the less educated. Thus, even into the nineteenth century, "*partially as a result of the absence of effective government control and partly from the rambunctious nature of these pioneers of* ***China's Wild East***", as noted by a Chinese officer's well-known words, Taiwan "*was known as a place where there was minor revolt every three years and a major one every five years*" (Gold 1986, pp. 25).

With respect to the developmental trend affecting population redistribution, two distinct trends over the eighteenth century are worthy of stressing. The first, largely triggered by the growing trade with China, was the development of both the port of Lu-kang and the commercial center of Changhua (located near present-day central Taiwan's Taichung[2] City) in the mid eighteenth century. The second, and the most important, was ***the redirection of immigration "port of entry"*** from both Tainan and Lu-kang to northern Taiwan's Bangkap (the developmental origin of Taipei[3] City) in the late eighteenth century, leading to the emergence of Taipei City as well as the development of northern Taiwan.[4] However, despite the growing importance of northern Taiwan's Taipei, even in the nineteenth century southern and central Taiwan remained the most populated place, and the Tainan area was still the island's trade and commerce center.

---

[2] "Taichung" in Taiwanese means "the central part of Taiwan".

[3] "Taipei" in Taiwanese means "the northern part of Taiwan".

[4] The main reason for such a redirection was that, since 1786 the society of central and southern Taiwan had been wracking by social unrest produced by the largest peasant rebellion, led by Lin Suang-weng, against the Ching Dynasty's authorities (HSu 1980, pp. 207-211).

In spite of the "Ban on Mountain Cultivation" policy, the activities of cultivation during the first half of the nineteenth century exhibited the following two trends. The first was the tentative movement of peasant farmers into ***eastern Taiwan***, particularly the northeastern Gomalan delta plain (present-day Ilan area) and the southeastern sea-coasts (present-day southern Taitung area). The second was the movement into the basin in the mountains of central Taiwan (present-day Nantou area). However, both trends had little effect in redistributing the population out of the populated areas, partly because of the serious resistance of the aborigines (Hsu 1980, pp. 151-152).

In the mid nineteenth century, facing the growing threats from both the Western Powers and the emerging Japanese Empire, the Ching Dynasty finally came to realize the strategic importance of Taiwan for China, leading to (1) the abolishment of the "Ban on Mountain Cultivation" and (2) the encouragement of cultivating the undeveloped eastern Taiwan (present-day Hualien and Taitung areas) through the assistance of the armed forces (Hsu 1980, pp. 154-156). Although these measures barely had any instant impact, they might have laid the groundwork for the trend of ***eastward migration*** in the 1920's. By the end of the nineteenth century, another important event affecting subsequent population redistribution should be attributed to ***the relocation of the governor*** from Tainan to Taipei in 1887. It was expected that such a relocation would have an effect of accelerating the growth of northern Taiwan. However, with the defeat of the Chinese Empire by the emerging Japanese Empire in a war in 1895, Taiwan was ceded to Japan and the society thus entered into another era with a history totally different from that of China thereafter.

In sum, the Dutch colonization and the subsequent regime of the Chengs since the first half of the seventeenth century initiated large waves of Chinese immigrants and the

development of settlement system in Taiwan, with the Tainan area being the core. Consistent with the World Systems Theory (Wallerstein 1974), the onset of immigration into Taiwan could be attributed to the European capitalist system's expanding demand for raw material and cheap labor. The large inflow of Chinese immigrants from southeast China during the eighteenth century, known as the "golden era" of immigration, was related to the push of warfare, overpopulation and poverty on the coastal areas of China and facilitated by the established migration channel. Within Taiwan, there were major redistributions of both the aborigines and immigrant population during the eighteenth century: the stretch of immigrant peasants into southern and central plains vis-a-vis the retreat of the aborigines into mountains. With the cultivatable lands in western Taiwan being mostly occupied during the nineteenth century, cultivation activities finally were extended to the mountain areas as well as to the northeastern, southeastern, and thereafter eastern Taiwan, despite the serious resistance of the deprived aborigines.

3.3 The Era of the Japanese Administration and Infrastructural Development: 1895-1945

The history of Taiwan being an open land to immigration came to an end as Taiwan fell into the jurisdiction of the Japanese Empire in 1895. The population of Taiwan gradually evolved into a nearly ***closed system*** through a government policy which successfully cut the ties with China. Although Taiwan's population reached about six million by the end of 1945[5], an increase of about three and a half million since 1895, it is not so surprising that the growth rate of population was very close to the rate of natural growth during the period of

[5] The Japanese population are not taken into account. In 1945, the actual number of the Japanese amounted to more than 400 thousand in Taiwan (Chen 1979, pp. 97).

1895-1945 (Barclay 1954, pp. 12-17; Chen 1979, pp. 101-103; Kuznets 1979, pp. 16-19)[6].

Another important milestone of the society during this period was that, with the end of the resistance of the Taiwanese to the Japanese rule in the 1910's, the loose frontier-type society was gradually transformed into a well-organized and more modern system. However, since the very beginning, the Japanese Empire continued to treat Taiwan as a ***supplier of agricultural products*** to industrializing Japan. The government invested heavily in developing the agriculture of Taiwan, and finally led to the formation of a mutually complementary economic relationship: agricultural Taiwan and industrial Japan (Lee 1971). As a result, except for sugar-refining and food-processing industries, the economy of Taiwan remained largely agrarian by 1930.

Based on the 1930 census reports, Barclay (1954, pp. 104-109) shows that although the population of Taiwan in 1930 had increased by more than 2 million since 1895, reaching a size of around 4.5 million, the most populated places were still the southern Tainan area and the central Taichung area, both of which ranked before the northern Taipei prefecture [7] where the capital (Taipei City) was located. With regard to internal migration, Barclay

---

[6] After 1910 with epidemics being wiped out or under control, Taiwan's population entered the second phase of demographic transition, i.e., sharply declining death rate with birth rate remaining high. During the Japanese administration, natural increase in effect accounted for 96 percent of population increase. For details, see Chen (1980, pp. 101-114),

[7] During the Japanese jurisdiction, Taiwan was divided into eight prefectures: Taipei, Hsinchu, Taichung, Tainan, Kaohsiung, Taitung, and Hualien. Taipei Prefecture includes present-day Taipei City/Hsien, Keelung City, and Ilan Hsien; Hsinchu Prefecture includes present-day Taoyuan Hsien, Hsinchu City/Hsien, and Miaoli Hsien; Taichung Prefecture includes present-day Taichung City/Hsien, Changhwa Hsien, and Nantou Hsien; Tainan Prefecture includes present-day Yunlin Hsien, Chiayi City/Hsien, and Tainan City/Hsien; Kaohsiung Prefecture includes present-day Kaohsiung City/Hsien, and Pingtung Hsien;

indicates (1) that migration flows were ***not voluminous***, and (2) that migrations mostly involved short distances and still played a minor role in redistributing the population. However, the migration process during 1925-30 still possessed some distinctive spatial patterns. First, major cities as expected were the gainers. Second, rural areas exhibited two different net migration patterns: a net loss in the north and a more or less neutral rate in the central and the south. Third, mainly through policy encouragement, the underdeveloped eastern Taiwan (Hualien and Taitung) started experiencing rapid settlement development. Although the number of in-migrants to eastern Taiwan was not large, this trend of migration signified ***the onset of eastward migration*** in Taiwan.

However, in the early 1930's, a milestone of Taiwan's economic development was that the government decided to shift its emphasis from agrarian to ***industrial development***. Reasons for such a drastic shift in developmental strategy were twofold. On the economic side, there was not much extra land to extend Taiwan's agriculture. On the political and military side, in the face of possible warfare in the near future as the Japanese Empire started implementing the so-called ***"southward policy"***, Taiwan's strategic location became evident and it thus became urgent to industrialize the island in order to support future military needs. This shift of developmental policy led to ***the onset of industrialization*** in Taiwan (Barclay 1954, pp. 28-31; Chen 1980, pp. 31-35).

An important outcome of industrialization in the 1930's was that the direction of the economy's ***intersectoral net capital flow***, which culminated in 1940, was an outflow from the agricultural into industrial sector, with the flows of labor following the same direction

---

Taitung Prefecture and Hualien Prefecture is present-day Taitung Hsien and Hualien Hsien, respectively.

(Lee 1971). As a result, the gross value of industrial production in 1939 started to outweigh that of agriculture (Barclay 1954, pp. 37-38). Although the process of industrialization had affected the structure of employment and had an effect of promoting occupational mobility, Japanese settlers were more affected than the native-born Taiwanese and the society in essence was still agrarian-based . For example, by 1940 about 65 percent of the Taiwanese workforce remained in the agricultural sector (Barclay 1954, pp. 56-65).

Parallel to the process of industrialization in the 1930s, Taiwan's regional economy began evolving into a distinct spatial pattern persisting to the present day, namely, ***the formation of a dual-pole (north-south) pattern***, in which Taipei City and Kaohsiung City served as the economic center for northern and southern Taiwan, respectively. The development of northern economic pole was mainly due to that (1) Taipei City became the political center[8] and (2) that its satellite seaport city, Keelung, became more important because of its nearest location to Japan. On the other hand, the emergence of the southern seaport city, Kaohsiung, was closely related to a government's aggressive plan of developing a ***"one-million-population industrial district"*** that could be advantageous to the Empire's preparation for war as well as the planned expansion toward Southeast Asia. Henceforth, Kaohsiung City was gradually developed into the largest sea-port city based on the growing heavy and chemical industries (Chen 1980, pp. 74-75; 102-103).

Consistent with the experiences of other countries, the process of industrialization in Taiwan in the 1930's also had a strong effect on the redistribution of population. An important outcome was ***rapid urbanization***. Based on the census reports, Chen (1979, pp.

---

[8] Selya (1995) provides a very comprehensive accounting of Taipei's development and evolution.

171-173) indicates that the proportion of population residing in urban settlements of more than 100,000 residents was only 4.5% in 1920 and 5.0% in 1930 but jumped to 12.3% in 1940. Although none of the cities of Taiwan during the Japanese administration evolved with the process of industrialization into great metropolis, the inequalities in the growth of cities still stood out prominently. Barclay (1954, pp. 114-117) indicates (1) that in 1920-40 the major cities of southern Taiwan (Kaohsiung, Chiayi, and Pingtung) and central Taiwan's Taichung City had much higher growth rates than their counterparts in the rest of the island, and (2) that the growth of cities was highly correlated with the gain of migrants rather than the natural increase.

As revealed by Table 3.1 which is originally derived by Li (1976) from the reports of population censuses of 1920, 1930, and 1940, the temporal pattern of migration during the Japanese administration can be summarized by the following features. First, in general prefectural lifetime out-migration share turned out to be more invariant over time than prefectural lifetime in-migration share, suggesting that in-migration might be more easily affected by developmental change such as industrialization in the 1930's. Second, by 1920 central Taiwan's Taichung area was still an attractive place for migrants, whereas the rapidly industrializing southern Taiwan's Kaohsiung area attracted increasingly large share of in-migrants through the 1930's and even became the most attractive region by 1940. Third, northern Taiwan's Hsinchu[9] turned out to be the least attractive during the Japanese administration. Fourth, the trend of eastward migration since the 1920's grew even stronger with time. However, the destination of this trend was mostly limited to Hualien prefecture.

[9] As will be mentioned later, Hsinchu City became "Taiwan's Silicon Valley" in the late 1980s.

Table 3.1. Percentage Share of Lifetime In-migrants and Out-migrants by Prefecture: Based on the 1920, 1930 and 1940 Censuses.

Prefecture	1920		1930		1940	
	Out-Migrants	In-Migrants	Out-Migrants	In-Migrants	Out-Migrants	In-Migrants
Total	100	100	100	100	100	100
North Region						
Taipei	16	19	15	16	14	15
Hsinchu	50	8	49	4	42	2
Central Region						
Taichung	11	26	9	22	13	13
South Region						
Tainan	12	18	11	17	17	15
Kaohsiung	9	13	5	22	5	28
Penghu	1	4	2	4	0	8
East Region						
Hualien	1	12	1	14	1	19
Taitung	-	-	8	1	8	0

Source: Li(1976), Table 3

Notes:

1. Taipei consists of present-day City and Hsien of Taipei, Keelung City, and Ilan Hsi
2. Hsinchu consists of present-day Taoyuan Hsien, City and Hsien of Hsinchu, and Miaoli Hsien.
3. Taichung consists of present-day City and Hsien of Taichung, Changhwa Hsien, and Nantou Hsi
4. Tainan consists of present-day Yunlin Hsien, cities and Hsiens of Chiayi and Taina
5. Kaohsiung consists of present-day City and Hsien of Kaohsiung, and Pingtung Hsi

In sum, impact of immigration on Taiwan's population could be totally ignored during this period. The Japanese administration's policy of making Taiwan a major supplier of agricultural products to Japan contributed to a substantial improvement in agriculture and helped maintain the concentration of Taiwan's population in the plains of southern and central regions. However, the expansion of Taipei as the capital city and the concentration of industrial development in Kaohsiung City in the 1930s led to the formation of a dual-pole

regional economic pattern. Although volume of migration remained low, urbanization accelerated in the 1930s and the trend of migration to the settlement frontier of eastern Taiwan continued. Net transfers of migrants into the major cities, especially Taipei and Kaohsiung, could be well explained by neoclassical economic theories.

3.4 The Era of Chaotic Times and Retrogression: 1946-1950

In sharp contrast to the 50-year period of stable socioeconomic development under the politically repressive administration of the Japanese[10], the 1946-50 period for Taiwan was marked by chaos and setbacks in socioeconomic and political orders. In this period, three very important events are worthy of highlighting because they had very far-reaching impacts on the population system and society of Taiwan.

The first was the takeover of Taiwan by the government of ***the Republic of China*** (thereafter ROC) in late 1945 after World War II as Japan was defeated by the United States. One accompanying outcome was the inflow of Chinese Mainlanders in conjunction with the repatriation of Japanese residents. The initial impact was not on the size of population. Rather, it was on the socioeconomic and political orders due to the vastly different experiences between the Taiwanese and the newcomers. Because the new authorities coming to Taiwan were seen by the Taiwanese to be incapable of managing the society, tensions between the two groups inevitably grew (Hsu 1980, pp. 729-738; Gold 1986, pp. 49-50).

The second was the so-call ***2-28 Incident,*** which broke out in Taipei City on

---

[10] Despite severe bombing on military and industrial targets since late 1944, warfare damages in Taiwan were not too comprehensive as compared to Japan, because neither (1) the situation of an overwhelming bombing by US B-29 bombers on mainland Japan nor (2) the situation like the bloody battle of Okinawa ever happened in Taiwan.

February 28th of 1947. This incident led to an island-wide massacre of the Taiwanese people, mostly the elites and the most educated, committed by the Chinese troop (Kerr 1965; Hsu 1980, pp. 780-788).[11] An important aftermath of this tragedy was a drastic change in the attitude among the Taiwanese masses: a change from hospitality to hostility (Gold 1986, pp. 50-52). This changed attitude produced a profoundly deterring effect on the process of assimilation between both groups. For example, ***"native domicile"***, which identifies a location in China for the newcomers, henceforth became a major concern of marriage in the society.

The third, and the most important, was a ***heavy influx*** of nearly two million civilian and military refugees into Taiwan in 1949-50, accompanying the retreat of the ROC central government to Taipei City when it was defeated by the Chinese communists who established the government of People's Republic of China (thereafter PRC) in Peking in 1949. Unfortunately, the end of China's civil war in 1949 did not end the historical antagonism between the newly retreated Kuomintang (the Nationalist Party, thereafter KMT) led by Chiang Kaishek and the Chinese Communist Party (CCP) led by Mao Zedong. Rather, the front line was just shifted from China's inlands to Taiwan Strait.

In the face of imminent invasion from communist China and in a fear of the infiltration of communism, the ROC government in Taiwan soon closed the door of immigration from China except for a few cases. One important impact of this policy was that Taiwan's population became a nearly ***closed system again*** in the next four decades, similar to the situation during the Japanese jurisdiction. Mainly because of the historical legacy of

---

[11] The total number of victims was estimated to range from 10,000 to 20,000 (Kerr 1965, pp. 310).

the antagonism between the KMT and the CCP, even in the late 1990s Taiwan still shows no sign of relaxing such a strict control on immigration from China.

In light of the aforementioned important historical events, it is worthy of briefly describing the characteristics, distribution, and migration behaviors of Chinese Mainlanders in Taiwan. Because many Chinese intellectuals, professionals, entrepreneurs and elites also came with the retreat of the ROC's central government, the human capital of civilian Chinese Mainlanders was not so unfavorable as that of those coming before 1949. Also, mostly due to (1) northern Taiwan's seaport Keelung City as the primary port of entry, (2) the language difference with the Taiwanese, and (3) the lack of indigenous societal ties, Chinese Mainlanders mostly settled in more urbanized areas, particularly the Taipei area and other larger cities. As a result, they accounted for ***the major source of urban growth*** in this period (Speare 1974).

As a consequence of the huge influx of Chinese Mainlanders into the urban sector, the distribution of Taiwanese population, particularly urban residents, might have been greatly affected. Although there had been evidences showing that the direction of internal migration from 1948 to 1951 in Taiwan was characterized by urban-to-rural net out-migration (e.g. see Wu and Tsai 1977), there are insufficient data to ascertain the extent to which urban-to-rural migration of this period was caused by ***the displacement effect*** of huge immigration, as having been seen, for example, in the United States in the 1980's (Frey and Liaw 1998).

In terms of migration behavior, Chinese Mainlanders were also different from the Taiwanese. First, largely because of possessing no indigenous societal ties and viewing the

island as a temporary place of residence, they exhibited a far ***higher emigration propensity*** than the Taiwanese, leading to a temporally declining share in the total population of Taiwan. Second, because a large proportion of them was the retreated soldiers, mostly single males, who had great difficulty in getting married in Taiwan, the mainlanders had disproportionately ***higher internal migration rate*** than the Taiwanese (Speare 1974). Because the migration behaviors of the mainlanders in most cases were not tied to the established societal structure, the remaining discussions will be limited to the Taiwanese population.

In sum, Taiwan had never experienced in its history such a huge influx of immigrants in such a short period of time. Behaving like typical new immigrants, Chinese Mainlanders mostly concentrated in the Taipei area and other larger cities so that they were the major source of urban growth during this period. As a result, they might have produced a displacement effect on the urban Taiwanese residents. Due to the lack of data in this chaotic period, the situations of internal migration of the Taiwanese population remained unclear.

3.5 The Era of Rehabilitation: 1951-1960

With the military threat from communist China as well as the sudden increase of domestic population which reached a size of more than 8 million (Figure 3.1), the very beginning of the 1950s for Taiwan was a very tough time. "*[W]ithout Taiwan's former abundant exportable agricultural surplus and export markets, and hampered by a lack of foreign exchange*" (Gold, 1986, pp.73), ***stabilization policies*** became the top priority for the new KMT government. With the assistance of ***the US economic aid*** (Scott 1979),[12] the

[12] During this rehabilitation period, the US economic aid played a very substantial role in stabilizing the economy and the social order of Taiwan. In the 1950s and early 60s,

government stressed the importance of developing agriculture and started to implement an ***import-substitution policy*** by promoting light industry to sustain domestic consumption (Thorbecke 1979; Kuo 1983, pp. 285-295; Li 1988, pp. 26-28).

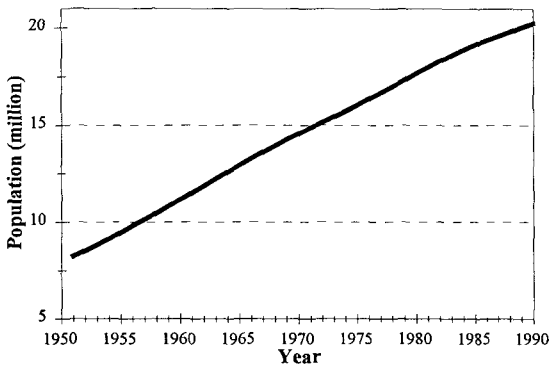
For agricultural development, the most important government programs were (1) a series of peaceful and successful ***land reforms***, particularly the Land-to-the-tiller Act in 1953[13], and (2) an aggressive program of agricultural extension directed by the Sino-American Joint Commission on Rural Reconstruction (***JCRR***) (Clark 1989, pp. 124-127, 159-167). The land reforms had the effects of raising the production aspiration of farmers and reducing the feelings of relative deprivation among rural residents due to the resulting more ***equitable property distribution.*** Together with the introduction of new agricultural techniques through the assistance of the JCRR, these changes increased rural laborers' willingness to remain in agriculture. Therefore, these developmental measures helped reduce the pressure on rural out-migration (Speare 1974). In addition to rural residents, absentee landlords residing in urban areas were also affected by land reforms. As noted by Wu and Tsai (1977), some of them moved back to rural areas to deal with land transfer matters or to hold on to part of their farmlands.

---

the US economic aid amounted to 1,296 million US dollars and Taiwan received considerably more aid per capita than other developing countries. For details, see Scott (1979, pp. 369-378).

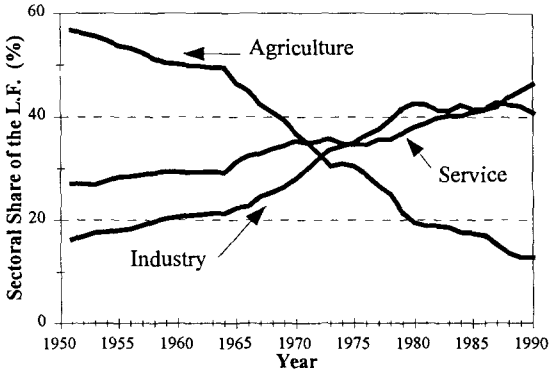
[13] Factors contributing to the success of land reforms were complex. The most important included (1) the KMT's strong feeling of "survival crisis", (2) the strong desire of the KMT to reform as having learned from past failure lessons in China, and (3) the absence of native elites who had been almost wiped out in the 1947 2-28 Incident.

Figure 3.1. Population Size of Taiwan: 1951-90.



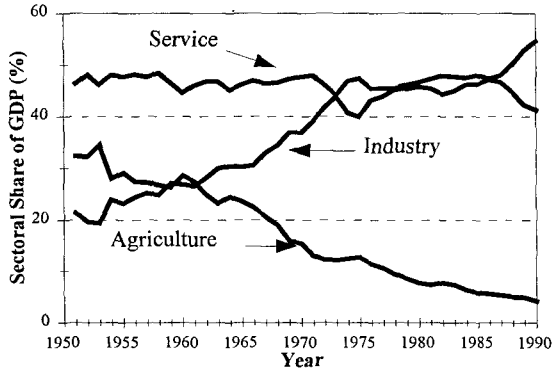
Source: DGBAS (1994)

Figure 3.2. Sectoral Percentage Share in the Total Labor Force of Taiwan: 1951-90.



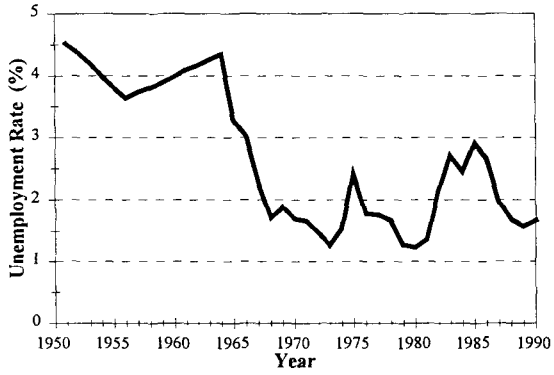
Source see Figure 3.1.

Figure 3.3. Sectoral Percentage Share in GDP of Taiwan: 1951-90.



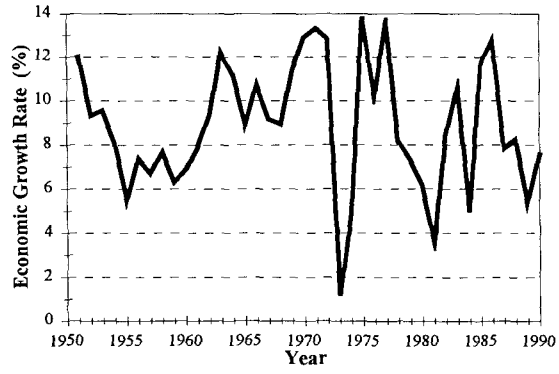
Source: see Figure 3.1.

Figure 3.4. Unemployment Rate of Taiwan: 1951-90.



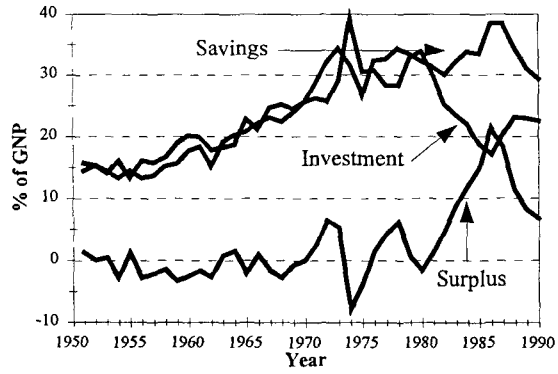
Source· see Figure 3 1

Figure 3.5. Economic Growth Rate of Taiwan: 1951-90.



Source: see Figure 3 1

Figure 3.6. Gross Domestic Savings and Investment, and Gross Net Savings Surplus of Taiwan: 1951-90.



Source· see Figure 3 1

Although the land reforms and agricultural development measures had produced a deterring effect on rural-to-urban migration and even led to a temporary rural net in-migration in the early 1950's, the government's effort in promoting light industry to sustain domestic demand led to a large amount of rural population being absorbed by the growing industrial sector. For example, in terms of both employment and GDP, the share of the agricultural sector followed a mild declining trend (Figures 3.2 and 3.3); by the end of the 1950s, the industrial share of GDP became nearly equal to the agricultural share.

Thus, with respect to the impacts of economic development strategy and policy on rural out-migration, the positive effect of developing light industry was in aggregate stronger than the retention effect of land reforms and other agricultural development measures. During the 1951-62 period, internal migration was characterized as a rural-to-urban net transfer and exhibited the following two broad patterns (Table 3.2). First, the gain of population due to migration for the major cities was at the expense of the net loss of rural population in general, with both cities of Kaohsiung and Taipei as the most attractive places. Second, the trend of eastward migration since the 1920's remained ongoing, with Hualien Hsien[14] having a net migration rate as high as that of Taipei City. These patterns suggests that migration during this period continued reflecting the developmental legacy of the Japanese administration.

Another important development in the 1950s was the onset of the formation of Taipei metropolitan area in the late 1950s (Chen 1979, pp. 547-552; Speare et al 1988, pp. 62-71).

---

[14] After the World War II, the 8 prefectures of Taiwan were reorganized into 16 "Hsiens" and 7 major Cities. Since both the administrative level of "hsien"/city is similar to the level of prefecture, the subsequent discussions will use "prefecture" as a general term to represent the administrative level of "hsien"/city for the sake of simplicity.

As shown in Table 3.2, the suburban prefecture (Taipei Hsien) had an average annual rate of net migration gain (1.9%) nearly as high as the rate associated with Taipei City (2.0%) in1951-62. By contrast, there was still not much improvement in the falling attractiveness of central Taiwan's Taichung area since the 1930's. For example, in terms of the average annual net migration rate, both cities of Taipei and Kaohsiung had a rate of 2.0% and 2.4%, respectively, whereas the corresponding rate for Taichung City was only 0.7% (Table3.2).

Table 3.2. Average Annual Rate of Net Migration for the Periods of 1951-62, 1963-74, 1975-80, and 1985-90 by Prefecture.

Region/Prefecture	1951-62	1963-74	1975-80	1985-90
North Region				
Taipei City	2.01	2.32	0.38	0.18
Keelung City	0.96	0.07	-1.24	-0.70
Taipei Hsien	1.90	3.15	4.44	1.24
Ilan Hsien	-0.55	-1.24	-1.16	-0.89
Taoyuan Hsien	0.02	0.73	1.68	0.90
Hsinchu Hsien	-0.61	-0.95	-1.07	-0.06
Central Region				
Taichung City	0.74	2.19	0.23	1.35
Taichung Hsien	-0.90	-0.63	0.77	0.51
Miaoli Hsien	-1.11	-1.34	-1.54	-1.09
Changhwa Hsien	-1.10	-1.26	-1.16	-0.85
Nantou Hsien	-0.39	-1.25	-1.43	-0.92
Yunlin Hsien	-0.95	-1.76	-2.01	-1.50
South Region				
Kaohsiung City	2.36	3.41	0.69	0.01
Tainan City	1.08	0.55	0.14	0.21
Kaohsiung Hsien	-0.60	-0.07	0.21	-0.28
Tainan Hsien	-1.22	-1.55	-1.30	-0.26
Chiayi Hsien	-0.96	-1.77	-1.94	-0.90
Pingtung Hsien	-0.47	-1.00	-1.08	-0.93
Penghu Hsien	-1.75	-2.68	-2.23	-1.31
East Region				
Hualien Hsien	2.05	-1.20	-1.59	-0.72
Taitung Hsien	0.23	-1.04	-1.07	-1.34

Sources: The data of 1951-62, 1963-74, and 1975-80 are mainly derived from Speare et al (1988), Table 5.2. based on household registration, whereas the data of 1975-80 are derived from the 1980 census, and the data of 1985-90 from the 1990 census.

It is worthy of noting that although Taiwan had gradually recovered from past nightmares, the outlook of Taiwan in the late 1950s was still gloomy and the achievement of economic development in fact was limited, mainly because of the sustained military antagonism between the KMT and the CCP as an extension of the Cold War throughout the 1950's. In the second half of the 1950's, the military antagonism even got worse, leading to the well-known Taiwan Strait Crisis in late 1958. As a result, the unemployment rate exhibited a rising trend (Figure 3.4) and the economic growth rate declined (Figure 3.5). Under such an unfavorable condition, it is likely that low level of rural out-migration prevailed in the late 1950s.

In sum, the promotion of light industry helped sustain a net transfer of migrants into urban areas in the 1950s. However, since the highly successful land reforms contributed to not only an increase in agricultural productivity but also a reduction in the sense of relative deprivation among a large number of farmers, the level of rural out-migration could not have been voluminous (Stark 1991). The large net gains of migrants by Taipei City and Kaohsiung City were particularly noteworthy. Also, the trend of eastward migration since the 1920's remained very strong. It seems that the migration process and the trend of population redistribution in the 1950's were still deeply affected by the legacy of the development strategy of the Japanese administration.

3.6 The Era of Economic Takeoff: 1961-1973

In the very beginning of the 1960's, the need for adjusting the strategy of economic development became urgent. In response to changes in the level and pattern of domestic and external demand, the government started implementing a set of new policies in the hopes of attracting ***direct foreign investment (DFI)*** to promote exports, domestic investment and

industrialization. As opposed to the 1950's import substitution strategy, the main feature of developmental strategy in the 1960's was shifted to the emphasis of developing ***export-oriented industries*** (Ranis 1979, pp. 221-227; Kuo 1983, pp. 300-309; Li 1988, pp. 28-30).

However, Taiwan's efforts in attracting DFI appeared to be quite unsuccessful at the outset. It was not until the mid-1960's when indigenous investment climate and external factors became matured that international capital began targeting this market.[15] Comparable to the 1950's milestone (land reforms), a turning point of the economic development in the 1960's was the establishment of the first ***Export Processing Zone (EPZ)*** in southern Taiwan's Kaohsiung City in 1966 that was very successful in attracting DFI and providing job opportunities.[16] Within a few years, a couple of dozens of Industrial Parks were also set up, mostly located in southern and northern Taiwan. As a consequence of these industrial development and the active promotion of export, substantial foreign trade deficit of the past two decades came to an end in the second half of the 1960's, and the economy of Taiwan was ready to take off.

Compared with the relatively lower annual economic growth rate of about 7% in the 1950's, the economic growth rate of the 1960's rose to a sustained high level of around 10% per year (Figure 3.5). Because of the strong economic growth, unemployment level exhibited

---

[15] One important external factor contributing to such improvement was the reducing military threat from China as it fell into the economic disaster and societal chaos brought about by Mao Zedong's Great Leap Forward in the late 1950's and the succeeding self-destructive Cultural Revolution since the second half of the 1960's (Clark 1989, pp.95). Others included the relaxation of cold war, the availability of cheap energy, the rapidly expanding world economy, and a sound international finance system (Kuo 1983, pp. 311).

[16] Because the establishment of Kaohsiung EPZ proved so successful, in 1969 a larger EPZ was opened in Kaohsiung City, and a smaller one near central Taiwan's Taichung City.

a very sharp downward trend (Figure 3.4). Together with the strong economic growth was the increasing importance of the industrial sector versus the shrinking agricultural sector in the economy (Figure 3.3), leading to a drastically changing structure of employment. For example, the share of labor force engaging in agricultural activities exhibited the greatest decline in history, a decline from 50% in 1960 to about 30% in 1973 (Figure 3.2). Therefore, there must be ***a significant transfer of rural labors*** from the agricultural into non-agricultural sectors. Meanwhile, two demographic developments also proved important in accounting for the fast declining share of labor force in agriculture during this period. The first was the timing of ***post-war baby boomers*** entering the labor market being consistent with the timing of the fastest growing demand for labor in the industrial sector. The other was ***the declining fertility rate*** and ***the trend of marriage postponement*** that enabled females to participate more in non-agricultural economic activities (Mueller 1977).[17]

Therefore, it is not so surprising to see that ***massive rural-to-urban migration*** and fast urbanization accompanied fast industrialization in the 1960's. In light of the changing economic situations, it was noted by Speare (1974) that the behaviors of migrants were economically rational. Similar to the experiences of other countries, migration during this period was selective of the more educated males and females (Speare 1974; Chang 1979). Females were observed to be more migratory at their young adult age than their male counterparts (Chang 1979). Although females tended to be less educated and were in secondary economic status in the society relative to their male counterparts (Tsay 1987), the fast-growing labor-intensive industries in the 1960's was supported to a large extent by the

[17] In spite of the declining fertility rate, the population of Taiwan continued to grow in the next three decades (see Figure 3.1), mainly because of the so-called population momentum.

labor of young female migrants from rural areas, whose ***remittances*** might be as important as those sent by rural male out-migrants in supporting the economic base of rural areas.

With respect to the spatial pattern of migration, internal migration during 1963-74 possessed the following distinct characteristics (Table 3.2). First, mostly triggered by the rural-urban disparities in economic opportunity, the contrast between the declining population base of rural prefectures and the rising population base of major cities became much more evident than that of the previous decade, suggesting that migration during this period played the major role in resizing a place's population. Second, lasting for nearly half a century since the 1920's, the trend of ***eastward migration*** finally came to an end in the 1960's, and both of the eastern prefectures started to experience net out-migration.

Although cities were the major winner of migration, their migration gains turned out to be very unequal (Table 3.2). Southern Taiwan's Kaohsiung City remained to be the place with the highest average annual rate of net migration in the 1960's. This phenomenon was closely related to ***the formation of Kaohsiung metropolitan area*** in the 1960's (Liao 1988). On the other hand, in contrast to the increasing attractiveness of central Taiwan's Taichung City, both northern Taiwan's seaport city, Keelung, and southern Taiwan's historical core, Tainan City, particularly the former which seemed unbeatable during the Japanese administration, turned out to be very unappealing to migrants and were seen to decline further.

In spite of Kaohsiung City's sustained attractiveness since the 1930's, the 1960's was the period in which northern Taiwan's Taipei metropolitan area started to grow very rapidly by absorbing the most number of migrants (Speare et al 1988, pp. 62-68). As estimated by

Tsay (1982) using household registration data, about 82% of Taipei area's population growth between 1968 and 1973 was contributed directly or indirectly by in-migrants (51% due to net migration and 31% due to the natural increase of lifetime in-migrants). The ***rapid suburbanization of Taipei metropolitan area*** in this period was reflected by the fact that the average annual net migration rate of Taipei Hsien (3.15%) began surpassing that of Taipei City (2.32%) in 1963-74 (Table 3.2).

Despite massive rural-to-urban migration, the level of migration and the corresponding problems (e.g. Tsai 1978) were not as voluminous and serious as those seen in other developing countries during the comparable period. As indicated by Speare (1974), one reason was that migration in Taiwan possessed a characteristic similar to the so-called ***stepwise migration*** (Ravenstein 1989) in the sense that the medium-sized townships served the function of absorbing a certain amount of rural out-migrants. The other reason should be attributed to the process of ***rural industrialization***, which had a function of offering jobs for both non-farm workforce and off-farm farmers during non-farming season (Selya 1974; Ranis 1979). For example, according to Wu and Tsai (1977), seasonal workers accounted for more than one half of rural out-migrants in the early 1960's; in spite of the increasing cases of permanent rural out-migration, the temporary migrants' share of total migrants in the late 1960's was still as high as 26%.

In sum, in conjunction with favorable external conditions, the shift of economic development policy from import-substitution to export-promotion strategy in the early 1960's led to a period of unprecedentedly fast industrialization and economic prosperity lasting to

the first oil crisis in 1974[18]. Accompanying the rapidly changing socioeconomic structure was the massive rural-to-urban migration as well as the rapid concentration of population in the large urban areas. During this period, the most important features of migration were (1) the end of a long-term net transfer of migrants to the settlement frontier of eastern Taiwan since the 1920's, (2) the formation of Kaohsiung metropolitan area, and (3) the onset of rapid sub-urbanization of Taipei metropolis. The large net transfer of migrants to high wage areas provided support for the neoclassical economic theories of migration, whereas the large remittances sent back by rural out-migrants confirm an important part of the New Economics Theory (Stark 1991).

3.7 The Era of Industrial Restructuring: 1974-1984

The first ***oil crisis*** in 1974 ended the 1960's economic prosperity, leading to a sharp decline of economic growth rate from about 13% in 1973 to about 1% in 1974 (Figure 3.5). Massive rural-to-urban migration since the 1960's must have been affected to a large extent by such a serious economic recession. For example, in light of the slightly rising share of labor force engaging in the agricultural sector in 1974 (Figure 3.2), ***return migrations*** of former rural out-migrants might have increased to the extent that rural areas experienced a temporary net gain of migrants during this period of recession. Although the economy turned out to recover quickly within a couple of years, ***other external shocks***, including the termination of ROC's formal diplomatic relationship with the United States in 1978, contributed to the continuation of poor economic outlook in the late 1970s (Figures 3.4 and

[18] In addition to the oil crisis, Taiwan started to face the problem of political isolation from the rest of the world, following (1) the replacement of the seat of ROC in the United Nations by PRC in 1971, and (2) the termination of ROC's formal foreign relationship with Japan in 1973.

3.5). In the wake of these external shocks, either economic or political, as well as being aware that Taiwan's export-oriented labor-intensive industry might lose its global competitiveness in the face of competition from Southeast Asian countries and China in the near future, the government planned to increase the economic strength of Taiwan by shifting domestic economic structure toward ***heavy and capital-intensive industries***.

However, the second oil crisis in 1979-80 seriously shook the economy again and nearly wrecked the nation's heavy and petrochemical industries, which were mostly located in southern Taiwan's Kaohsiung area. The policy makers immediately abandoned the original upgrading strategy and shifted promptly to the emphasis on developing ***technology-intensive***, non-polluting, and non-energy-gobbling industries (Gold 1986, pp. 97-102; Li 1988, pp. 209-236).[19] In retrospect, this sudden shift of development strategy at the end of the 1970s was a ***crucial turning point*** for the succeeding industrial development of Taiwan. To realize this new policy, in 1980 the first Science Park was established in northern Taiwan's Hsinchu City, a city just outside the commuting sphere of Taipei City and notorious for its unpleasantly windy winter. By the end of the 1980s, it was developed into ***"Taiwan's Silicon Valley"***[20] and a leading industrial center. This shift in policy had the effects of not only reshaping regional development but also consolidating and extending the economic power of the Taipei area. As a consequence, northern Taiwan, as the most

---

[19] By the end of the 1970s, Taiwan competed with South Korea in the international market very intensively, because both had very similar industrial structures. However, mainly due to different emphasis on the restructuring strategy, Taiwan and South Korea began to differ from each other in economic structure in the 1980s.

[20] By the year of 1995, Taiwan had surpassed Germany in the gross production value of information industries, ***just ranking behind the United States and Japan***. Thus, the importance of Hsinchu City in Taiwan's economy becomes self-evident.

attractive destination for migrants, was further strengthened.

In sharp contrast to the emerging new industrial center in northern Taiwan's Hsinchu City, the importance of southern Taiwan's Kaohsiung City in the national economy began to decline substantially from the very beginning of the 1980s. This decline can be attributed to not only economic but also political factors. With respect to the economic factor, the declining importance of Kaohsiung City was related to the severe blow of the second oil crisis on its ever-advantaged labor-intensive, heavy and petrochemical industries. Regarding the political factor, there occurred in Kaohsiung City in late 1979 a large scale anti-KMT political mass rally demanding for democracy and human rights. Unfortunately, this rally in the end turned into a violent conflict famously known as the ***"Formosa Incident"*** (Gold 1986; pp.111-121). Because this incident was perceived by the KMT as a serious challenge to its authoritarian polity at that time, it might have weakened the subsequent support from the ruling party for southern Taiwan's economic development and the region's investment climate.

In addition to the economic and political backgrounds mentioned above, some macro economic phenomena are worthy of further highlighting, because they were related to the migration process in the decade of 1975-84. First, the trend of the declining agricultural share of total labor force had two distinct patterns: (1) a sharp descent in the second half of the 1970's that was stronger than the trend of the 1960's, and (2) a moderate decline in the first half of the 1980's similar to that in the 1950's (Figure 3.3). Second, although the secondary industry became the leading sector in terms of employing the most number of workers, the growth trend of its share in total labor force ceased since 1980 (Figure 3.2) and the growth of its share in GDP began to slow down dramatically as opposed to the 1960's situation

(Figure 3.3). Third, domestic economic investment during 1980-86 declined very sharply as opposed to the steadily rising trend during previous decades, leading to a growing gap with the rising domestic savings (Figure 3.6).

As a result, not only could ***the year of 1980*** be viewed as a crucial divide of this transitional era in terms of Taiwan's economic and regional development, 1980 was also a turning point for migration and population redistribution. For example, Liao (1988) using the household registration data demonstrates (1) that in 1976-80 migration had barely contributed to the population growth of Taipei City, whereas about 23% of Kaohsiung City's population growth was due to migration, and (2) that in 1981-85 migration contributed as much as 48% of Taipei City's population growth, but the corresponding figure for Kaohsiung City was only 3%. Therefore, the subsequent discussion on migration will deal with the situations before and after the year of 1980, respectively.

According to the 1980 census (Table 3.2), the pattern of migration during the period of 1975-80 still resembled very much that of the previous decade, namely, the trend of rural-to-urban migration. Nevertheless, there still existed two distinct characteristics worthy of highlighting. First, the level of rural out-migration declined substantially (Speare et al 1988, pp. 84-92), and the growth of urban population slowed down (Liao 1988). The slowdown of the urbanization process was related to the unfavorable economy. It was also related to ***the depletion of rural population base*** as a result of massive rural out-migration in the previous decade, although the transfer rate of agricultural labor force to other sectors in 1975-80 remained as remarkable as before. It could also be attributed to ***the completion of the freeway system*** through which commuting between non-metropolitan and metropolitan areas became more feasible and hence reduced the need for making permanent migration (Chen

1992).

Second, partly related to the completion of freeway system, the phenomena of ***nation-wide sub-urbanization*** became more evident. The medium-sized townships, particularly those in the satellite prefectures of Taiwan's three largest cities, exhibited a growing strength in attracting migrants (Liao 1988). For example, over the 1975-80 period, it was seen (1) that the scope of suburbanization of Taipei metropolis was extended further to Taoyuan Hsien, (2) that Taipei Hsien became the most attractive destination for migrants, surpassing the dominating status of Kaohsiung City since the 1930's, and (3) that both cities of Kaohsiung and Taichung also exhibited the sign of sub-urbanization (Table 3.2).

Now let us turn to the situations after the year of 1980. Although the official surveys of internal migration indicate that both migration volume and migration rate in Taiwan exhibited a declining trend during the first half of the 1980's (DGBAS 1981-1985), the restructuring toward knowledge-based industries was accompanied by the further strengthening of ***educational and industrial selectivity*** in migration. For example, using the 1983 and 1985 official surveys of internal migration, Chen (1988) indicates that, relative to non-migrants, migrants were more likely to take high-tech jobs and contributed more to the restructuring process than non-migrants. Consequently, northern Taiwan (particularly both cities of Taipei and Hsinchu) on average should be the place enjoying an improvement in their human resources, while southern Taiwan's rust-belt (the Kaohsiung area) is expected to experience the opposite.[21]

---

[21] Based on the 1990 census, labor migration as a response to the changing regional economic structure turned out to be even more prominent in the second half of the 1980's. For details, see Chapter 4, 5, and 6.

In light of the socioeconomic transition, the pattern of migration in Taiwan was also in another phase of transition during the first half of the 1980's. For example, based on the 1981-85 official surveys of internal migration, Chen and Speare (1988) find (1) that migration in Taiwan basically was at a stage in accordance with "the hypothesis of the mobility transition" (Zelinsky 1971) for an industrialized society, (2) that although rural-to-urban migration still accounted for about half of total migration, urban-to-rural migration was seen to rank as the second most important migrational flow, and (3) that the importance of inter-metropolitan migration was emerging.

In sum, the period of 1974-84 marked an era when massive rural-to-urban migration since the early 1960's gradually came to an end. In addition to the unfavorable economy and the depletion of rural population base, the completion of freeway system in the second half of the 1970's was also important in accounting for the declining migration level and island-wide sub-urbanization. In conjunction with the transitions in the socioeconomic and political development, migration and the trend of population redistribution in Taiwan were also in transition. With the year of 1980 as the most crucial divide, one striking outcome after 1980 was the shift of the ever-balanced dual-pole regional economy toward ***the single-pole pattern:*** the attraction of northern Taiwan was further enhanced, whereas southern Taiwan's Kaohsiung area became rather unattractive to migrants. Also, in spite of the fall in the volume and rate of migration, ***the educational selectivity of migration*** became more evident than ever, mostly related to the restructuring toward high-tech industries. These migration responses to the changing economic reality are quite consistent with the neoclassical economic theories.

3.8 The Era of Development Toward a Pluralistic and Open System:

1985-1990

In the second half of the 1980's, there were several important political and socioeconomic developments that had direct and indirect effects on the migration process in Taiwan. The most important was probably the far-reaching polity reform, the so-called ***"quiet revolution"***, in 1986-88 that was initially launched by President Chiang Ching-kuo and mainly implemented by President Lee Teng-hui thereafter (Copper 1988, pp. 27-43; Clark 1989, pp. 136-147). This "revolution" in the end terminated the KMT-style authoritarian political structure. For Taiwan, this process of ***political liberalization*** proved very crucial to the subsequent development. On the economic side, it accelerated the pace of liberalizing and ***globalizing domestic economic market***, laying the groundwork for the growth of service sector, particularly in the Taipei area. On the social side, it remarkably helped activate the society as well as raise individual's aspiration for ***social mobility***, as having been witnessed by the "abrupt" emergence of numerous social movements in the late 1980's.[22] Consequently, the second half of the 1980's in effect marked the onset of Taiwan's transition toward a pluralistic society.

The other important development was ***the economic boom*** and the emergence of ***"bubble economy"***. Although the economy of Taiwan had been recovering since 1984, with the growth rate peaking in 1988 (Figure 3.5), there was a very ***serious mismatch*** between domestic savings and domestic investment: the former was rising, whereas the latter was declining (Figure 3.6).[23] Reenforced by a heavy influx of foreign ***"hot money"*** pursing the

---

[22] The most noticeable were Consumer Right Movements, Ecology Conservation Movements, Labor Movements, Student Movements, and Women's Movements (Tien 1988).

[23] The rising level of domestic savings was primarily due to the bulk of cumulated trade surplus, whereas the declining domestic investment can be partially attributed to the

substantially appreciating Taiwanese dollars in the late 1980's,[24] this peculiar phenomenon in the end resulted in a sharply ***rising money supply*** and caused domestic markets, particularly housing and stock markets, to become overheated. As a result, the economic activities in the end was characterized as being very speculative until the crash of stock market in late 1990, which marked the end of this booming period.

In essence, the economic conditions of 1985-90 became very advantageous to ***the growth of service sector*** but, due to such problems as rising production costs and serious labor shortages, was unfavorable to conventional manufacturing (Tsay 1993). As a result, the structure of domestic economy was changing rapidly in this period: the growing importance of service sector versus the decline of conventional industrial sector. As a result, the share total of employment by the industrial sector dropped slightly from 41.6% to 40.8%, whereas the corresponding share by the service sector increased sharply from 41.0% to 46.3% (Figure 3.5). In terms of GDP, the share of the industrial sector dropped from 46.3% to 41.2%, whereas the share of the service sector increased dramatically from 47.9 % to 54.6% (Figure 3.6).

Because of (1) the shift in development from industrial to service sector and (2) the increasing economic strength of northern Taiwan since the year of 1980, ***the employment growth*** became spatially very uneven. For examples, the 1991 Census of Industry and

---

feelings of uncertainty during the period of political transition.

[24] In the second half of the 1980s, the appreciation of the Taiwanese currency was particularly remarkable. Its value against the US dollar appreciated by 47%. Meanwhile, the Korean "won" and the Singaporean dollar appreciated by less than 20% and the currency of Hongkong remained stable (Tsay 1993).

Commerce (DGBAS 1993) shows that during 1986-91 the number of entrepreneur establishments grew by 21% at the national level, 27% for northern Taiwan, 20% for central Taiwan, but only 15% and 14% for southern and eastern Taiwan, respectively; and that at the prefectural level, the corresponding growth rates were all over 30% for both northern and central Taiwan's economic centers (Taipei City and Taichung City, respectively) but only 14% for southern Taiwan's economic center (Kaohsiung City). In light of such uneven spatial pattern of economic opportunity, it is not surprising that there were increasing complaints from southern Taiwan's local governors and political elites on the ***"Emphasize-the-North, and Ignore-the-South" policy*** of the central government toward the end of this period.

As a result, labor migrations also responded effectively to the changing socioeconomic situations in the comparable period. The average annual net migration rates in Table 3.2 suggest that the interprefectural migration process responded strongly to the new spatial pattern of employment opportunities: 1.35% for central Taiwan's Taichung City and 1.24% for northern Taiwan's Taipei Hsien, compared with only 0.01% for southern Taiwan's Kaohsiung City and -0.28% for its satellite, Kaohsiung Hsien. It will be shown in later chapters that the uneven distribution of high-skilled jobs was reflected by a strong educational selectivity in interprefectural labor migrations. The responses of labor migrations to the spatial disparity in economic opportunities will be studied in detail in Chapters 4 to 6.

In light of ***the economic globalization*** and ***the growing high-tech industry***, the educational selectivity of labor migration during this period became even more evident and aggravated the spatial polarization in the quality of human resources. By analyzing the 1990

census, labor migrants in general did move to places where the economic structure met their educational training. For example, in terms of net migration rate, Taipei city functioning as a "world city" (Sassen 1988) distinctly selected the more educated and deselected the less educated (-4.1% for the at-most primary educated, -1.6% for the junior high educated, 1.8% for the senior high educated, and about 5.0% for the at-least college educated). By contrast, despite receiving the most number of migrants, its satellite (Taipei Hsien) did not exhibited a clear educational selectivity pattern. Hsinchu City (Taiwan's Silicon Valley) selected mostly the most educated (about 2.5% for the at-most senior high educated, 6.3% for the college educated, but as high as 23.1% for the at-least university educated); Kaohsiung city (the rusted conventional industrial center of Taiwan) selected the middle-level educated (-1.0% for the at-most primary educated, 0.4% for the junior high educated, 1.4% for the senior high educated, 1.1% for the college educated, and only 0.2% for the at-least university educated). The detailed situations will be discussed in the subsequent chapters.

Responding to the socioeconomic development and political liberalization in the late 1980s, international migration gradually grew in importance and became a concern of the society. Two important cases were worthy of highlighting. First, there was a large increase in the ***emigration of the elderly Chinese Mainlanders*** (mostly single veterans) back to their Chinese hometowns, as the government opened the door of visiting China by humanitarian consideration. Second, due to the serious shortages of unskilled labor, voluminous ***foreign laborers*** (mostly from Southeast Asian countries), either legal or illegal, began penetrating the secondary sector of the labor market. Despite strict government control, illegal immigration from China, mainly a response to Taiwan's booming economy, also increased in the meanwhile. By the early 1990s, foreign laborers became so numerous that aboriginal

laborers started to complain that their jobs were taken away by the foreign laborers (Selya 1992; Tsay 1992 and 1994).

In sum, the trend of economic restructuring and globalization as well as the political "quiet revolution" had brought about several fundamental changes in 1985-90. The employment in the service sector grew rapidly, whereas the employment in industry started to decline. The change from the two-pole growth pattern of previous decades to the one-pole domination became even more evident. In a highly selective way, internal migration responded quickly to these changes. There was also a marked increase in international migration, including the emigration of the Chinese Mainlanders back to their hometowns in China and the inflows of legal and illegal foreign laborers. Thus, the neoclassical economic theories remain helpful in explaining the internal migration in this period. Meanwhile, the emerging importance of the immigration of foreign labor calls for more attention to the theories of dual labor market (Piore 1979) and world systems (Sassen 1988).

3.9 Conclusion

This chapter has explored the links between migration, the settlement system and the various stages of socioeconomic development in Taiwan over the past four hundred years. Except for the chaotic period of 1946-50, migration of each developmental stage responded well to the changes of regional economies and has been influenced by the development strategies and government policies.

Before the 1950s, the development of Taiwan was influenced substantially by external forces. With the expansion and development of maritime trade activities in the Far East in the seventeenth century, the development of Taiwan as well as the onset of the

Chinese immigration was induced by the need of the Dutch colonial power (1624-1662) for land, labor, raw materials. The second wave of the Chinese immigrants came with the Chengs (1662-1682) who came form southeastern China and defeated the Dutch. The significance of both regimes was the establishment of an immigration port-of-entry and the introduction of an agrarian economy. The initial base, Taioan (the present-day Tainan area of southern Taiwan), remained to be the most populous area for more than 200 years until the expansion of the cities of Taipei and Kaohsiung during the Japanese administration in the early part of the 20th century.

During the inactive rule of the Chinese Ching Dynasty (1683-1894), the Chinese immigrants, mostly from southern Fukien and partly Kwangtung of Southeast China, continued to cross the Taiwan Strait in spite of the ban on emigration from China, leading to the formation of new settlement bases in central and northern Taiwan. As the settlers spread out from these bases, wars between clans and with the aborigines occurred frequently. The Chinese immigrants who came to Taiwan before the Japanese administration could be characterized as rambunctious risk-takers. Their legacy of the willingness to take risks helps explain the high efficiency of migration and the breadwinners' high migration propensities in Taiwan that will be revealed in later chapters.[25]

It was the active Japanese administration (1895-1945) that finally succeeded in transforming Taiwan from a frontier-type to an orderly society. Meanwhile, immigration from China was terminated. Through government encouragement, cultivation activities in

[25] In contrast to South Korea when the economy is dominated by a few very large corporations, Taiwan has an economy consisting of numerous small and medium enterprises. This reflects the pervasive desire of the Taiwanese to control their own economic activities, probably a cultural trait preserved from the settlement history.

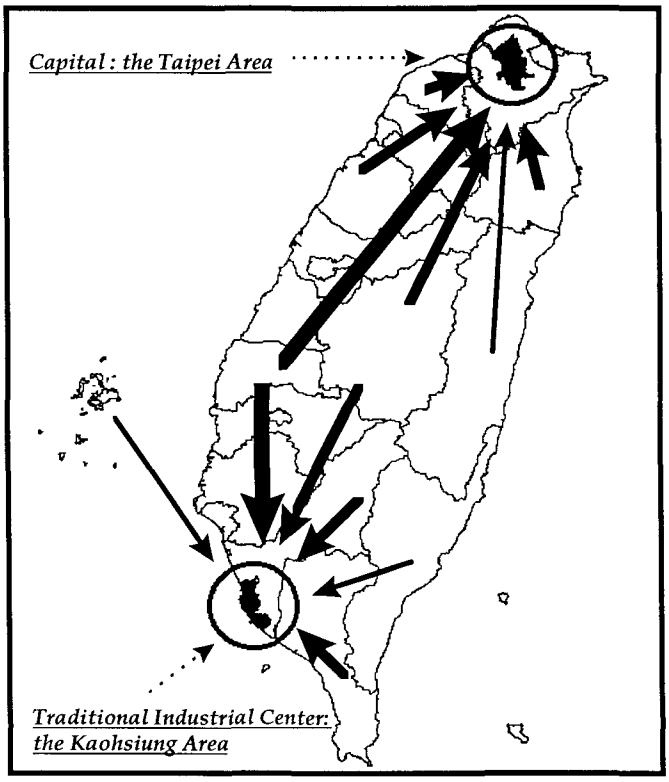
eastern Taiwan became intensified, leading to the onset of eastward migration in the 1920s. The Japanese Empire's Southward Policy triggered the onset of industrialization in Taiwan, leading to the emergence of Kaohsiung City as an industrial center in the 1930s and the formation of a dual-pole (north-south) regional economic pattern (Taipei vis-a-vis Kaohsiung). Closely related the industrialization, urbanization was seen to occur. Although not voluminous, internal migration did respond to the differential development of regional economies.

It was the civil war of China after the World War II that brought about a huge influx of Chinese Mainlanders into Taiwan during the chaotic period of 1946-50. In spite of such huge immigration from China, the socioeconomic network between Taiwan and China remained unestablished in the next four decades, because of the political and military antagonism between the KMT and CPP. Because the Chinese Mainlanders mostly concentrated in larger cities, the native-born Taiwanese urban residents might have been displaced, as having been documented by the urban out-migration.

The internal forces, especially the economic policies of the KMT government, started to play more important roles in the development of Taiwan since the 1950s. The development of light industries (e.g. food processing and textile) did not result in large rural-to-urban migration in the 1950, because successful land reforms and rapid technological development in agriculture helped increase the carrying capacity of rural areas. Throughout the 1950s, the spatial population dynamics appeared to reflect the legacy of development in the period of Japanese administration: a concentration toward the northern and southern poles, and the net transfer of migrants to the settlement frontier of eastern Taiwan.

The 1961-73 rapid economic growth was accompanied by a massive rural-to-urban net transfer of migrants (especially to the northern and southern poles, see Figure 3.7), rapid suburbanization of the Taipei metropolitan area, and the termination of eastern Taiwan's net gain of migrants. Despite the huge net loss of rural human resources, large remittances sent back by rural out-migrants helped prevent the decline of rural economic base. In contrast to many other developing countries, the massive urbanization did not result in a serious unemployment problem in urban areas and extensive rural poverty.

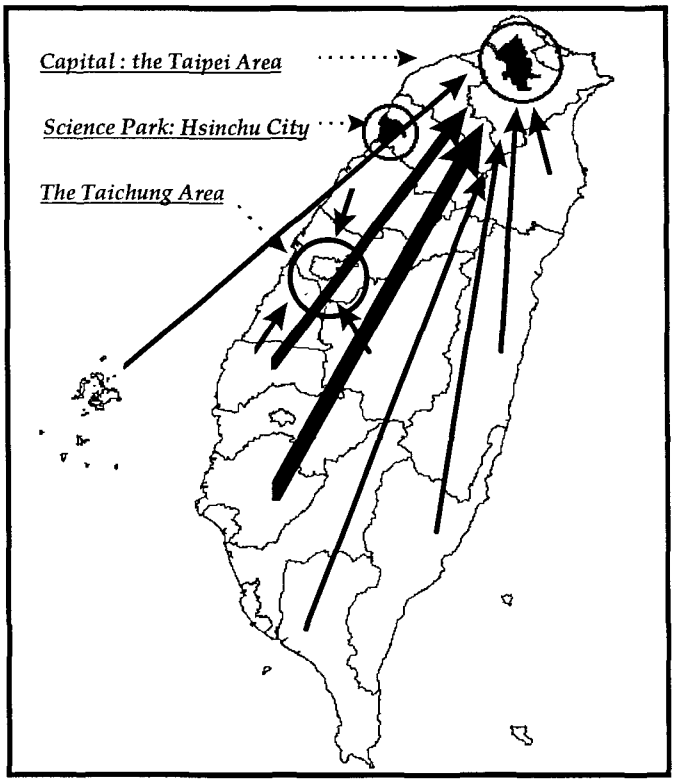
Figure 3.7: Flows of Labor Migrants in the 1930s - 70s.



In 1974-84, the oil shocks of 1974 and 1979 and the increasing competitions from other developing countries forced Taiwan to switch to the development of high-tech industries. The most important was the successful establishment of a large-scale Science

Park in Hsinchu City in 1980. By contrast, unable to shift from its dependence on heavy and petrochemical industries, Kaohsiung City lost its attractiveness to migrants, leading to the emergence of one-pole concentration in the Taipei area (see Figure 3.8).

Figure 3.8: Flows of Labor Migrants in the 1980s.



In 1985-90, the impacts of economic restructuring and globalization as well as political liberalization became apparent. The pattern of one-pole growth was intensified by the emergence of Taipei as a "world city" and the success of high-tech industries in Hsinchu City as "Taiwan's Silicon Valley". In a highly selective way, internal migration responded quickly to these changes. Meanwhile, there was also a marked increase in international migration, including (1) the emigration of the Chinese Mainlanders back to China and (2) the increasing inflow of legal and illegal low-skilled foreign laborers, as a result of the

formation of dual labor market. Thus, the situations by the late 1980s suggested that the society of Taiwan was moving toward an open and pluralistic system.

The overall impression from this study is that migration in Taiwan appears to be highly responsive to the changing socioeconomic context. This responsiveness may be partly related to the risk-taking legacy of the society established by the Taiwanese's ancestors during the past centuries. Also, it may be related to other factors, such as the insignificant role of labor union in the market and the lack of a comprehensive unemployment insurance program by the end of the 1980s.

Chapter 4

Labor Migrations in Taiwan: Characterization and Interpretation Based on the Data of the1990 Census

4.1 Introduction

Taiwan's success in economic development in recent decades is an envy of many developing countries. A crucial factor contributing to this success is the efficient use of labor which helps make the products of Taiwan highly competitive in overseas markets. For various reasons (e.g. economies of agglomeration, constraints of transportation facilities, availability of large tracts of land for developing industrial parks, and concentration of political power), the economic growth of Taiwan has been spatially rather uneven. Thus, labor migration is a necessary condition for the efficient use of labor and hence the economic success.

The past trend of population redistribution and internal migration in Taiwan interacted largely with the evolutionary trend of regional economic development. Since the very beginning of Taiwan's development in the early seventeenth century, the nature of regional population redistribution, mostly driven by cultivation activities, was characterized by a northward trend spreading from South Region to Central Region, and finally to North Region. Meanwhile, the trend of population movement toward the last frontier of Taiwan, East Region, was not very prominent until the 1920's. Thus, although South Region served

as the original developmental hub, North Region as the most populous region in the end was a consequence of Taiwan's economic and political center being gradually switched from the south to the north (Chen 1979; Hsu 1980).

With the formation of urban economy since the late nineteenth century and the onset of industrialization in the 1930's in Taiwan (Barclay 1954, pp. 28-31; Chen 1979, pp. 171-173; Chen 1980, pp. 31-35), the trend of regional population redistribution was dominated by three major patterns. First, except for East Region, the prototypes of regional economic centers were gradually developed: the Taipei area of North Region, the Taichung area of Central Region, and the Kaohsiung area of South Region. Such a formation of regional economic centers laid the foundation of Taiwan's regional economic pattern nowadays (Liao 1988). The main reason for the failure of East Region to develop a sizable regional economic center was due to the constraint of its physical environments that hampered the inflows of population from other regions. Second, as the last frontier of Taiwan, East Region began attracting a number of agricultural workers from the remaining three regions (mostly from Central Region and partly from South Region) since the 1920's (Barclay 1954, pp. 104-109). Nonetheless, this eastward trend of agricultural migration came to an end in the 1960's, when Taiwan's economy was ready to take off. Third, with the agglomeration economies in urban areas, the general trend of population redistribution was dominated by a net transfer of population from rural to urban areas. A depopulation trend in rural areas culminated in the late 1960's as the economy of Taiwan was growing at a historical peak, with most of rural out-migrants ending up in the already populous northern Taipei area and the fast growing industrial southern Kaohsiung area (Speare et al 1988, pp. 62-71).

The aforementioned trend of population redistribution in Taiwan became much

affected by another phase of regional economic restructuring and infrastructural changes since the late 1970's (Gold 1986, pp. 97-102; Li 1988, pp. 209-236). The most fundamental change of population redistribution was the shift of a long-lasting dual-pole (north-south) concentration pattern developed since the 1930's toward a single-pole concentration pattern in northern Taiwan starting in 1980. This impressive turnaround of population redistribution was closely related to the following facts. First, because of (1) the globalizing domestic economic activities mostly being headquartered in the Taipei area and (2) the successful establishment of high-tech industry in Hsinchu City, the ability of North Region in retaining its residents and attracting labor, particularly the more educated, from other regions was strengthened and extended substantially. Second, mostly because of the inability of its regional economic center, the Kaohsiung area, to keep up with the restructuring trend, South Region became inevitably diminished in attractiveness.

Although the processes of labor migration in Taiwan appeared to be broadly similar to those in many other developing countries (e.g. large rural-to-urban net migration and strong concentration into the capital area), their mechanisms and, especially, outcomes may be quite different. For Taiwan, one impressive outcome of labor migration is that there has been neither massive urban unemployment nor extensive rural poverty. Thus, valuable lessons may be learned from a rigorous investigation into labor migration in Taiwan.

This chapter is to characterize and interpret patterns of labor migration in Taiwan as revealed by the data of 1990 census. Based on the information of native domicile (similar to birth place), we will study (1) the life-time labor migrations up to 1990 and (2) the 1985-90 labor migrations. The former will s how the cumulative effects of migrations that had occurred through several decades, whereas the latter is to associate labor migrations with the

socioeconomic developments in the 1980s. To gain better insights, the 1985-90 migrations will be decomposed into primary, return, and onward migrations (Long 1988). In light of the growing importance of economic restructuring and globalization in the 1980s, this chapter is particularly interested in educational selectivity of migrations and impacts of labor migrations on the spatial patterns of not only the quantity but also the quality of the labor force.

This chapter is structured as follows. Section 4.2 briefly introduces the data and types of migrants. Section 4.3 addresses patterns of lifetime labor migrations up to 1990. Section 4.4 deals with patterns of labor migrations in 1985-90. In light of the importance of economic restructuring and globalization in Taiwan during the 1980s, section 4.5 presents findings on the educational selectivity of interprefectural labor migration and its impacts on the interprefectural human resources. Section 4.6 concludes this chapter.

4.2 Data and Definitions of Migrants

From the full records of the 1990 Census of Taiwan, we selected records of those who (1) resided in Taiwan in 1985 and 1990, (2) were aged 20 and over in the civilian labor force in 1990, and (3) had their native domiciles in Taiwan.[1] Instead of asking place of birth, the census asked location of native domicile. Except for the "Mainlanders" who are excluded from the study[2], native domicile is a good proxy for place of birth for most of the Taiwanese.

---

[1] As revealed by the data, the size of population in Taiwan at the time of census (December 16th, 1990) amounted to 20,285,626 persons, of which 7,905,974 persons were in the labor force (5,247,411 males and 2,658,563 females). The labor force consist of employees, employers, the unemployed, and unpaid family workers.

[2] The term "Mainlanders" used in Taiwan refers to those who came to Taiwan from Mainland China after World War Two and their descendants born in Taiwan. The main

It was recorded in the census at the level of the 23 prefectures, including the 7 major cities and 16 "hsiens"[3]. The main reason for excluding the labor force in the 15-19 age group is that they were not the economically active population by definition in 1985. In total, the population in question amounts to 6,499,565 individuals.

This study involves two kinds of geographic units of migration. The first is the four officially-defined regions (North, Central, South, and East). Use of these large units enables us to eliminate most of the moves irrelevant to market forces and to focus more distinctly on the exchanges of the labor force among the major labor markets. The second is the set of 23 prefectures, which allows us to gain more insights into the effects of migrations on urbanization, suburbanization, and the differential growth of major cities.

The study of life-time migration is on the basis of regional level. A regional ***life-time migrant*** is defined as the person whose region of residence in 1990 was different from the region of native domicile. Otherwise, the person is a ***life-time stayer***. To study the 1985-90 interregional and interprefectural primary, return, and onward migrations, we compare the place (defined consistently using either the unit of region or prefecture) of native domicile and the place of residence in 1985 for each person. If the two places are identical, then the person is defined as a ***native***, otherwise as a ***non-native***. A native whose places of residence in 1985 and 1990 are different is defined as a ***primary migrant***. A non-native whose place

---

reason for excluding them in this research is that because the native domiciles of their children remained recorded as China-origin that we won't be able to identify their real birth places in Taiwan. They amounted to around 13 percent of Taiwan's total population in 1990.

[3] A "hsien" in Taiwan is equivalent to a prefecture in Japan and a state in the United States.

of residence in 1990 is the same as the place of native domicile is called a ***return migrant***. A non-native is called an ***onward migrant*** if his/her place of residence in 1990 is different from both the place of residence in 1985 and the place of native domicile. A ***repeat migrant*** refers to either a return migrant or an onward migrant.

4.3 Patterns of Life-time Labor Migrations

The distribution of the labor force by native domicile reflects the fact that before the rapid industrialization of the 1960s, Taiwan had been a densely settled country where the population distribution was determined mainly by the distribution of arable land,[4] with large part of non-agricultural labor force in the 1950s being employed in the processing and distribution of agricultural products.[5] According to the locations of native domicile revealed by the 1990 census, most of the individuals are concentrated in South Region (34.8%) and Central Region (34.7%) where the largest plain of this mostly mountainous island is located. In contrast, only 27.0% of the individuals have their native domiciles in North Region where the country's capital is located, and only 3.5% in East Region which was a settlement frontier until the late 1950s.

The net effect of life-time migrations up to 1990 was a net transfer of migrants into North Region from the remaining three regions (Table 4.1). Having achieved a net gain of 784,000 migrants, North Region increased its share of the country's labor force from 27.0%

---

[4] In 1956, population density of Taiwan was already as high as 261 persons per square kilometer of land area and 1,073 persons per square kilometer of cultivated land, with 50% of the population being agricultural (Chen 1959, pp. 201 and pp. 210).

[5] The share of manufacturing employment by food processing remained high through the 1950s and 1960s (23.5% in 1954, 23.1% in 1961, and 23.1% in 1966) and declined to a low level in the 1970s and 1980s (8.1% in 1976 and 6.5% in 1981) (Liu 1988, pp. 159).

to 39.1% and became by far the most populous region, with its life-time net migration rate being as high as 44.7%.[6] Central Region was the greatest net loser in terms of both net migration volume (-502,000) and net migration rate (-22.3%). The net loss of South Region (-245,000; -10.8%) was half of the net loss of Central Region. The net loss of East Region was small in terms of volume (-37,000), but was moderately high in terms of net migration rate (-16.4%). As a consequence of the massive loss of life-time migrants up to 1990, Central Region's share of Taiwan's labor force decreased by 7.7% (from 34.7% to 27.0%). The corresponding share by South Region decreased by 3.8% (from 34.8% to 31.1%), whereas the share by East Region decreased by only 0.6% (from 3.5% to 2.9%).

Table 4.1. The Effects of Inter-regional Life-time Migrations on the Redistribution of the Taiwanese Labor Force Aged 20+ in 1990: Based on the 1990 Population Census, Taiwan.

Region	Size (persons)			Distribution (%)			Net Mig. Rate (%)
	Labor Force by Native Domicile	Labor Force by 1990 Residence	Labor Force Life-time Net Mig.	Labor Force by Native Domicile	Labor Force by 1990 Residence	Change in Share of Labor Force	
Taiwan	*6,499,565*	*6,499,565*	-	*100.0*	*100.0*	-	-
North	1,754,686	2,538,715	784,029	27.0	39.1	12.1	44.7
Central	2,255,105	1,753,092	-502,013	34.7	27.0	-7.7	-22.3
South	2,263,298	2,018,348	-244,950	34.8	31.1	-3.8	-10.8
East	226,476	189,410	-37,066	3.5	2.9	-0.6	-16.4

It is important to point out that the massive net transfer of life-time migrants into North Region was not caused by the deteriorating economic conditions in the agricultural sector of the remaining regions. Rather, it was due to better income and employment opportunities in the secondary and tertiary sectors of North Region. While agricultural

[6] The life-time net migration rate of region *i* is computed by dividing the number of net migrants of region *i* by the number of individuals whose native domiciles were in region *i*.

employment in Taiwan increased somewhat from 1,642,000 in 1952 to a maximum of 1,747,000 in 1961 and then followed a declining trend to 1,317,000 in 1986, agricultural output was growing between 1953 and 1968 at the real annual rates of between 4% and 6% (Ishida 1988, pp. 49 and pp. 60).[7] In other words, agricultural productivity was improving significantly through the 1950s and 1960s. What is more impressive is that the productivity of the secondary and tertiary sectors was growing at even higher rates so that the per capita income of the agricultural sector was about 65% to 70% of that of the non-agricultural sector between 1966 and 1985 (Ishida 1988, pp. 66).

As shown in Table 4.2, an interesting feature revealed by the pair-wise net transfers of migrants is the net gains of life-time migrants by the least industrialized East Region from Central and South Regions: 7,633 and 1,980 migrants, respectively. This feature reflects the fact that East Region had been a settlement frontier until the late 1950s, attracting mainly farmers who were capable of opening up new farmlands. Although East Region is the least accessible to Central Region due to the blockage of Cental Mountain Ranges, the census indicates that a high proportion of the settlers came from the agricultural prefectures of Changhwa and Yunlin in Central Region, suggesting that proximity was not the most important factor for migration into this settlement frontier. In spite of the fact that East Region had become a net loser of migrants to all other regions since the 1960s due to rapid

---

[7] The increased productivity of Taiwan's agricultural sector can be attributed to a series of agricultural land reforms introduced by the government since 1949 (compulsory reduction of rent from 50% or more to 37.5%, distribution of public farm lands to peasants, and compulsory transfer of farm lands from large landlords to tenants at low prices), improvement in irrigation, and the adaptability of the farmers to new technology and changing markets. Responding to the increasing demands for animal products, there has been a trend of shifting from crop cultivation to animal husbandry since the early 1950s (Ishida 1988, pp. 49).

industrialization, the non-native share of East Region's labor force was still as high as 23.4% in 1990, mainly because most of the settlers had developed deep roots in East Region.[8] Note that East Region's life-time net migration rate of -16.4% is the balance of a very large net loss (-20.6%) to North Region and modest net gains from Central Region (3.4%) and South Region (0.9%).

Table 4.2. Inter-regional Net Transfers of the Taiwanese Labour Force Aged 20+ in 1990 from Native Domicile to the 1990 Residence: Based on the 1990 Population Census, Taiwan.

Native Domicile	Residence in 1990			
	North	Central	South	East
		Volume(Persons)		
Taiwan	*784,029*	*-502,013*	*-244,950*	*-37,066*
North	-	-470,555	-266,795	-46,679
Central	470,555	-	23,825	7,633
South	266,795	-23,825	-	1,980
East	46,679	-7,633	-1,980	-
		Net Migration Rate (% of Native Domicile Labor Force)		
Taiwan	*44.7*	*-22.3*	*-10.8*	*-16.4*
North	-	-20.9	-11.8	-20.6
Central	26.8	-	1.1	3.4
South	15.2	-1.1	-	0.9
East	2.7	-0.3	-0.1	-

The massive net transfer of life-time migrants into North Regions from the remaining three regions was the result of ***extremely efficient*** exchanges of migrants: the main streams were much greater than the corresponding counter-streams. As shown in Table 4.3, the migration efficiency was 88.8% against Cental Region, 84.2% against South Region, and

[8] In comparison, non-native share of the labor force was as high as 31.1% in North Region, 7.5% in Central Region, 7.8% in South Region, and 17.0% for Taiwan as a whole, respectively.

75.9% against East Region.[9] Note that the most efficient exchange was seen between North Region and Central Region that Central Region sent as many as 500,000 migrants to North Region, while received only 30,000 migrants in return.

Table 4.3. Flows of the Inter-regional Life-time Migrants of the Taiwanese Labor Force Aged 20+ in 1990 from Native Domicile to the 1990 Residence: Based on the 1990 Population Census, Taiwan.

Native Domicile	Residemce in 1990				Total
	North	Central	South	East	
		Volume (Persons)			
Taiwan	*846,035*	*101,375*	*121,751*	*35,380*	*1,104,541*
North	-	29,606	25,003	7,397	62,006
Central	500,161	-	86,986	16,241	603,388
South	291,798	63,161	-	11,742	366,701
East	54,076	8,608	9,762	-	72,446
	Out-migration Rate (% of Native Domicile Labor Force)				
North	-	1.7	1.4	0.4	3.5
Central	22.2	-	3.9	0.7	26.8
South	12.9	2.8	-	0.5	16.2
East	23.9	3.8	4.3	-	32.0
		Migration Efficiency (%)			
North	-	-88.8	-84.2	-75.9	
Central	88.8	-	15.9	30.7	
South	84.2	-15.9	-	9.2	
East	75.9	-30.7	-9.2	-	

On the other hand, the exchanges of life-time migrants that did not involve North Region were not only very small in volume but also very low in efficiency (Table 4.3). For example, despite being the two most populous regions by native domicile, Central Region

[9] For each pair of regions, migration efficiency is computed by dividing (1) the difference between in- and out-migration volumes by (2) the sum of in- and out-migration volumes. The measure is then expressed as a percentage. For comparison, the most efficient gainer (California) of quinquennial interstate migrants in the United States had the efficiency of 61.1% in 1935-40 (Long 1988, pp. 78).

sent only 87,000 life-time migrants to but received only 63,000 life-time migrants from South Region, leading to the migration efficiency being of only 15.9% and the net migrant rate being of only 1.1%. This very low efficiency suggests that most of the jobs created in the secondary and tertiary sectors in these two regions were taken by local residents and short-distance migrants. Consequently, these two regions are ***regional*** markets, whereas North Region serves is a ***national*** market in essence.

In sum, our analysis on life-time migration in Taiwan has shown (1) that the massive net transfer of migrants into North Region from the remaining three regions was extremely efficient; (2) that those who migrated to the least industrialized East Region before the 1960s had developed deep roots so that non-natives still represented a high proportion of the region's labor force in 1990; and (3) that North Region was a truly national market, whereas the remaining regions were clearly regional markets.

4.4 Patterns of Labor Migrations in the 1985-90 Period

4.4.1 Interregional Labor Migrations

North Region continued to be an impressive net gainer of migrants from all three remaining regions in the late 1980s. With a net migration rate of 3.4% in 1985-90, it achieved a net gain of 83,000 migrants: 33,000 from Central Region, 38,000 from South Region, and 12,000 from East Region (top panel of Table 4.4). In contrast to the traditional pattern of gaining mostly from Central Region, ***North Region gained most of the migrants in 1985-90 from South Region*** where the decline of some heavy industries was not well compensated by the growth of new industries. Note that region with the highest net out-migration rate (5.8%) in 1985-90 was, however, the least industrialized East Region.

Table 4.4. Volumes and Rates of Inter-regional Primary, Return, and Onward Migrations of the Taiwanese Labor Force Aged 20+ in 1990 : Based on the 1990 Population Census, Taiwan.

Region	At-risk Population		Migration Volume			Migration Rate		
	Volume (Persons)	Dist. (%)	In-mig. (Persons)	Out-mig. (Persons)	Net Mig. (Persons)	In-mig. (%)	Out-mig. (%)	Net Mig. (%)
				Overall				
Taiwan	*6,499,565*	*100.0*	*240,019*	*240,019*	*0*	*3.7*	*3.7*	*0 0*
North	2,455,565	37.8	139,045	55,895	83150	5.7	2.3	3.4
Central	1,786,305	27.5	51,282	84,495	-33213	2.9	4.7	-1.9
South	2,056,608	31.6	40,404	78,664	-38260	2.0	3.8	-1.9
East	201,087	3.1	9,288	20,965	-11677	4.6	10.4	-5.8
				Primary				
Taiwan	*5,494,758*	*100.0*	*160,308*	*160,308*	*0*	*2.9*	*2 9*	*0.0*
North	1,695,695	30.9	117,100	14,421	102679	6.9	0.9	6.1
Central	1,697,012	30.9	23,978	68,872	-44894	1.4	4.1	-2.6
South	1,937,188	35.3	15,369	62,054	-46685	0.8	3.2	-2.4
East	164,863	3.0	3,861	14,961	-11100	2.3	9.1	-6.7
				Return				
Taiwan	*1,004,807*	*100.0*	*60,574*	*60,574*	*0*	*6.0*	*6.0*	*0.0*
North	759,870	75.6	11,406	34,660	-23254	1.5	4.6	-3.1
Central	89,293	8.9	23,577	11,520	12057	26.4	12.9	13.5
South	119,420	11.9	21,463	10,978	10485	18.0	9.2	8.8
East	36,224	3.6	4,128	3,416	712	11.4	9.4	2.0
				Onward				
Taiwan	*1,004,807*	*100.0*	*19,137*	*19,137*	*0*	*1 9*	*1 9*	*0 0*
North	759,870	75.6	10,539	6,814	3725	1.4	0.9	0.5
Central	89,293	8.9	3,727	4,103	-376	4.2	4.6	-0.4
South	119,420	11.9	3,572	5,632	-2060	3.0	4.7	-1.7
East	36,224	3.6	1,299	2,588	-1289	3.6	7.1	-3.6

Note:
The at-risk population are the natives for primary migration, the non-natives for return and onward migrations.

By disaggregating the 1985-90 migrants into primary, return, and onward migrants, just like the situations in many other countries, the non-natives in Taiwan were much more migratory than the natives, with the out-migration rate being 7.9% and 2.9%, respectively (Table 4.4). Subject to the strong attraction of location-specific capital left in their native domiciles (Da Vanzo 1981), three quarters of non-native migrants were return migrants.

We find in Table 4.4 a couple of basic patterns that are similar to those of interstate and interdivisional migrations in the United States (Long 1988, pp.127-129; Rogers and Belanger 1990) and interprovincial migrations in Canada (Newbold and Liaw 1990). First, the overall net migration pattern is determined mainly by the pattern of primary net migration. Second, the effect of primary migration is partially canceled out by the opposite pattern of return net migration but is enhanced by the consistent pattern of onward net migration.

Relative to the major effect of primary migration, the countervailing effect of return migration was modest, whereas the reenforcing effect of onward migration was rather trivial. In other words, the overall migration pattern was mainly determined by the reactions of the natives to the changing economic opportunities in different regions. The overwhelming importance of primary migration is demonstrated by the fact that North Region had a net gain of 103,000 primary migrants, a net loss of 23,000 return migrants, and a net gain of less than 4,000 onward migrants.

It is important to note that North Region had an extremely strong power to retain its natives: its primary out-migration rate was only 0.9%, compared with 4.1% for Central Region, 3.2% for South Region, and 9.1% for East Region. North Region also had a very strong power to keep its non-natives: its non-native out-migration rate was 5.5%, in sharp contrast with the rate of 17.5% for Central Region, 13.9% for South Region, and 16.5% for East Region.

With respect to the large net transfers of migrants into North Region from all other regions in 1985-90, primary migrations continued to be highly efficient: the efficiencies in primary migration for North Region was 77.1% against Central Region, 79.4% against South

Region, and 77.5% against East Region. By contrast, the net transfers of onward migrants into North Region were much less efficient, mainly because as many as 75.6% of all non-natives in 1985 were already concentrated in North Region. The efficiencies in onward migration for North Region was 10.7% against Central Region, 24.6% against South Region, and 36.8% against East Region.

Having the return net migration rates of 13.5% and 8.8%, Central and South Regions were the main beneficiaries of return migration, with the net gains being 12,100 and 10,500 migrants, respectively. By contrast, the least industrialized East Region had a negligible net gain of 3,400 return migrants, suggesting that migration streams from East Region were like a "river of no return".

4.4.2 Interprefectural Labor Migrations

To gain more insights, we now switch to migrations at the prefectural level. According to the hierarchy of Taiwan's settlement system, the 23 prefectures are classified into the following four types: (1) metropolitan core prefectures (Taipei City, Kaohsiung City, and Taichung City); (2) suburban prefectures (Taipei Hsien, Taoyuan Hsien, Kaohsiung Hien, and Taichung Hsien); (3) other major cities (Keelung, Hsinchu, Chiayi, and Tainan); and (4) rural/peripheral prefectures (all remaining prefectures).

Within each of the four regions, we find that the process of urbanization continued into the late 1980s: all rural/peripheral prefectures had an overall net out-migration, whereas most of the major cities had an overall net in-migration (Table 4.5). In every rural/peripheral prefecture, there was a large primary net out-migration, countered by a small return net in-migration and reenforced by a small onward net out-migration. Since all rural/peripheral prefectures had some net gain of return migrants, counter-urbanization flows were quite

common among those who were disappointed with the outcome of previous urban-ward migration and then drawn back by the kinship/friendship networks in their native domicile prefectures. However, it is important to point out that rural/peripheral prefectures tended to have rather weak ability to attract their natives who had out-migrated. For example, in 1985-90 Yulin Hsien (a typical rural prefecture with 54.4% of employment in the primary sector) got back only 3.3% of its out-migrated natives. By contrast, Taipei City (a metropolitan core) and Taipei Hsien (a suburban prefecture) were able to get back as many as 11.2% and 12.2% of their previously departed natives.

Within North Region, migration patterns at the prefectural level were somewhat complex. With an extremely high population density of 10,200 persons per square kilometer, Taipei City, capital of the country, had a net loss of 10,000 onward migrants as well as a net loss of 11,000 return migrants, although it had a fairly large net gain of 30,000 primary migrants. Most of its net loss of onward migrants was to its suburban prefecture, Taipei Hsien, which also received a large number of primary migrants from prefectures of all regions and had the highest overall net migration rate (8.4%) and net migration volume (70,000) among all prefectures. Keelung City, a major seaport, was one of the only two prefectures that had a net loss of all three types of migrants. Although it had a substantial net gain of migrants in the past, Keelung City became rather unattractive to migrants in the late 1980s because of the continuous loss of its shipping function to the large international airport built in Taoyuan Hsien in 1978. Largely benefitting from the international airport and new factories and office buildings built along the highway between the airport and Taipei City, Taoyuan Hsien became a part of the expanding suburban area of Taipei and attracted large numbers of both primary and onward migrants in 1985-90: its net gain of 18,000 migrants was the second largest among all the prefectures. With the establishment of the country's

first Science Park in 1980 inside its city limit, which spearheaded the country's successful attempt at economic restructuring, Hsinchu City (just outside of the commuting sphere of Taipei City) was transformed from a lackluster city with unpleasantly windy winter to a net gainer of all three types of migrants in the late 1980s.

Table 4.5. Impact of Inter-prefectural Labor Migration on the Spatial Allocation of the Taiwanese Labor Force Aged 20+ in 1990 by Type of Migration: Based on the 1990 Population Census, Taiwan.

Geographic Unit		Labor Force in 1985		Source of Migrant Net Gain(Persons)				Net Change in L.F. Size(%) due to			
Prefecture	Region	Volume (Persons)	Non-nat. Share(%)	Overall Mig.	Primary Mig.	Return Mig.	Onward Mig.	Overall Mig.	Primary Mig.	Return Mig.	Onward Mig.
A. Northern Economic Center (the Largest											
Taipei City	N	761,936	59.0	9,143	30,273	-10,936	-10,194	1.2	4 0	-1.4	-1 3
Taipei Hsien	N	831,456	56 8	70,213	61,376	-6,997	15,834	8.4	7.4	-0.8	1.9
Taoyuan Hsien	N	371,292	30 7	17,917	14,753	-744	3,908	4 8	4.0	-0.2	1.1
B. Central Economic Center (the 3rd Largest)											
Taichung City	C	209,157	49 2	12,172	14,279	-3,710	1,603	5.8	6.8	-1.8	0 8
Taichung Hsien	C	397,549	19.6	11,727	7,844	1,447	2,436	2 9	2.0	0.4	0 6
C. Southern Economic Center (the 2nd Largest)											
Kaohsiung City	S	397,480	58.2	1,570	10,468	-5,097	-3,801	0.4	2.6	-1.3	-1.0
Kaohsiung Hsien	S	367,088	23 0	-2,882	-4,424	787	755	-0 8	-1 2	0.2	0.2
D. Other Major Cities											
Keelung City	N	105,388	39 4	-3,612	-1,294	-851	-1,467	-3.4	-1.2	-0 8	-1 4
Hsinchu City	N	90,705	26 9	4,192	2,839	67	1,286	4 6	3 1	0 1	1.4
Tainan City	S	206,191	35 9	2,241	4,121	-2,254	374	1 1	2.0	-1.1	0 2
Chiayi City	S	78,671	29 8	-1,924	-1,073	-485	-366	-2 4	-1.4	-0 6	-0 5
E. Rural/Peripheral Prefectur											
Hsinchu Hsien	N	137,240	8.7	-6,864	-6,917	960	-907	-5.0	-5.0	0.7	-0.7
Ilan Hsien	N	157,548	6.2	-7,839	-8,544	1,253	-548	-5.0	-5.4	0.8	-0.3
Changhwa Hsien	C	445,337	5 6	-18,202	-19,656	2,867	-1,413	-4.1	-4 4	0 6	-0.3
Yunlin Hsien	C	326,967	4 2	-20,115	-23,220	4,240	-1,135	-6.2	-7.1	1.3	-0.3
Miaoli Hsien	C	208,691	6 7	-10,505	-11,526	1,720	-699	-5 0	-5.5	0.8	-0.3
Nantou Hsien	C	198,604	10 3	-8,290	-9,681	2,205	-814	-4.2	-4.9	1.1	-0.4
Tainan Hsien	S	399,093	7.8	-7,698	-13,342	5,711	-67	-1.9	-3.3	1 4	-0 0
Chiayi Hsien	S	238,329	5 7	-13,114	-15,903	3,820	-1,031	-5.5	-6.7	1 6	-0 4
Pingtung Hsien	S	334,678	8.1	-14,309	-15,922	3,097	-1,484	-4 3	-4.8	0.9	-0 4
Penghu Hsien	S	35,078	4 3	-2,144	-2,870	1,022	-296	-6.1	-8 2	2 9	-0.8
Hualien Hsien	E	110,497	17 7	-5,276	-5,633	1,082	-725	-4.8	-5.1	1.0	-0.7
Taitung Hsien	E	90,590	22.7	-6,401	-5,948	796	-1,249	-7 1	-6.6	0 9	-1.4

Note: Nativity status (native versus non-native) is measured at the level of prefecture.

Within South Region, neither Kaohsiung metropolitan area (the second largest in the country) nor other major cities were major gainers of migrants in 1985-90. Kaohsiung City, the country's largest seaport city and the core of South Region, had been a major gainer of migrants in the 1960s - 70s but failed to move beyond its heavy dependence on the traditional heavy and chemical industries in the 1980s. Consequently, it had a negligible net gain of less than 2,000 migrants in 1985-90, which resulted from the balance of a net gain of 10,000 primary migrants, a net loss of 5,000 return migrants, and a net loss of 4,000 onward migrants. The 1985-90 performance of its suburban prefecture, Kaohsiung Hsien, was even worse: it had a net loss of 3,000 migrants, because its net gains of return and onward migrants were too small to compensate for its net loss of primary migrants. With its industrial base being food processing and other low-tech industries, Chiayi City had net losses of all three types of migrants. Only Tainan City, that had a high employment growth rate of 4.1% per year in 1985-90, had the typical pattern of a gaining prefecture: a large net gain of primary migrants, accompanied by a small net loss of return migrants and a mall net gain of onward migrants. The overall net migration rate of Tainan City was 1.1%, compared with 0.4% for Kaohsiung City, and -2.4% for Chiayi City.

In Central Region, Taichung City is the only major city and is also the core of Taiwan's third largest metropolitan area. Partly as a result of housing boom, this city had an overall net gain of 12,200 migrants, which was the balance of a net gain of 14,300 primary migrants, a net loss of 3,700 return migrants, and a net gain of 1,600 onward migrants. Its overall net migration rate of 5.8% was the second highest among all prefectures. Its suburban prefecture, Taichung Hsien, had an overall net migration rate of 2.9% and was one of the only two prefectures that had net gains of all three types of migrants.

In East Region, there are only two prefectures, Hualien Hsien and Taitung Hsien. With only 10.3% of the total employment in the manufacturing sector, Taitung Hsien was the least industrialized prefecture and had a negative employment growth rate of -0.2% per year in 1985-90. It is not surprising that Taitung Hsien had the most negative overall net migration rate of -7.1% among all prefectures in 1985-90. Being somewhat more industrialized, Hualien Hsien had a somewhat less negative overall net migration rate of -4.8%.

In sum, our descriptive analysis of the 1985-90 migration data yields the following main points about the situations in the late 1980s. First, North Region benefitted substantially from economic restructuring and globalization so that it continued to create a large number of job opportunities to attract migrants, whereas the attraction of South Region was weakened substantially by its continued heavy reliance on traditional industries. Second, the net transfers of primary migrants into North Region from the remaining regions were so voluminous and efficient that primary migration strongly dominated the countervailing return migration and the reenforcing onward migration. Third, at the prefectural level, we found (1) that all rural/peripheral prefectures, including those in North Region, had a net loss of large numbers of primary migrants, implying the continuation of the long-term trends of urbanization and the shift from agricultural to non-agricultural employment; (2) that the strong suburban expansion of the country's capital was reflected by the largest net migration gains accrued to its two suburban prefectures (Taipei Hsien and Taoyuan Hsien); and (3) that the net losses of all types of migrants by Keelung City and Chiayi City indicated that the continuation of urbanization process did not guarantee a net gain of migrants for all major cities.

4.5 Educational Selectivity of the 1985-90 Interprefectural Labor Migration

4.5.1 Educational Selectivity: Primary, Onward, and Return Migrations

Based on American and Canadian censuses, it has been found that the propensities to make primary and onward migrations tend to increase markedly with educational level, whereas the propensity of making return migration is rather insensitive to the differences in educational attainment (Long 1988; Newbold and Liaw 1994). An important implication of this finding is that regions with a large net grain of primary and onward migrants tend to experience an increase in not only the quantity but also the quality of its human resources. It is useful to know if this difference can also be observed in the 1985-90 interprefectural migration of the Taiwanese labor force.

To study the educational selectivity by the three types of migration, we control for age in order to reduce the risk of committing ecological fallacy.[10] Consistent with the American and Canadian findings, the propensities of making primary and onward migrations in Taiwan tended to increase with educational attainment in every age group (Figure 4.1: panels A and B). This tendency was particularly strong for the young adult age groups (20-24, 25-29, and 30-34). But, in most age groups, the differences in educational attainment up to the senior high level had little or no effects on the propensities of making both primary and onward migrations. It was the attainment of post-secondary educations that enhanced these propensities greatly. Take the 30-34 age group as an example, its primary migration rate increased from 9% at the senior high level, to 12% at the college level, 18% at the university

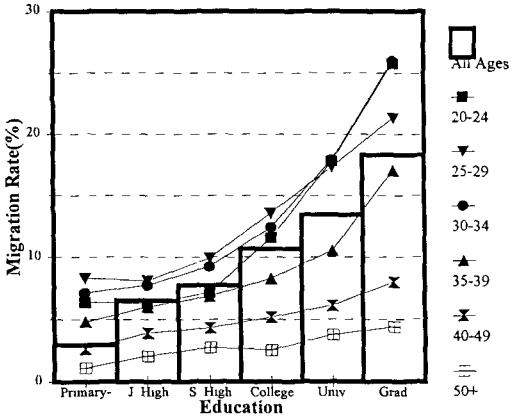
---

[10] A factor contributing to this risk is the negative correlation between age and educational attainment. The risk is most likely to occur under the conditions (1) that age selectivity is relatively strong, and (2) that educational selectivity is relatively weak.

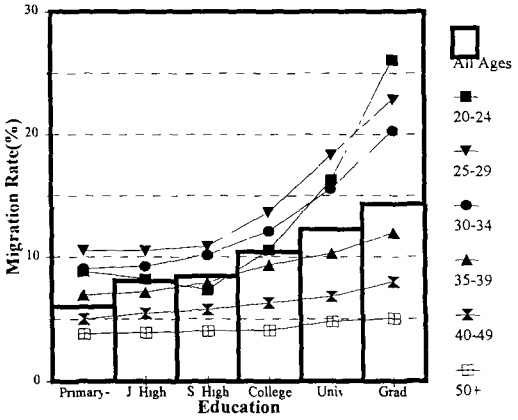
level, and 26% at the graduate level, whereas the onward migration rate increased from 10% at the senior high level, to 2% at the college level, 16% at the university level, and 20% at the graduate level. This finding suggests that the attainment of higher levels of education beyond senior high enhanced substantially the quantity and quality of the information about the opportunities available in different places.

Figure 4.1. Age-specific Educational Selectivity of Inter-prefectural Migration of the Taiwanese Labor Force Aged 20+ in 1990: Overall Pattern and Primary, Return, and Onward Migrations.

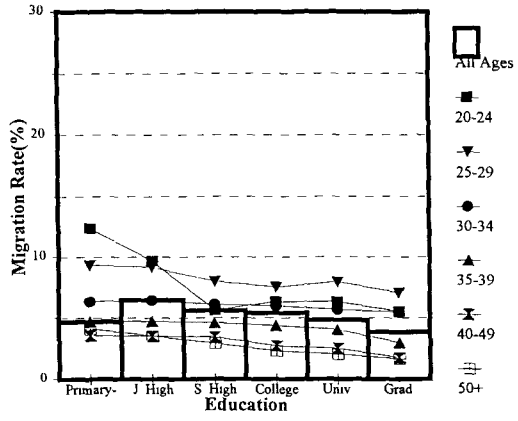
(A) Primary Migration



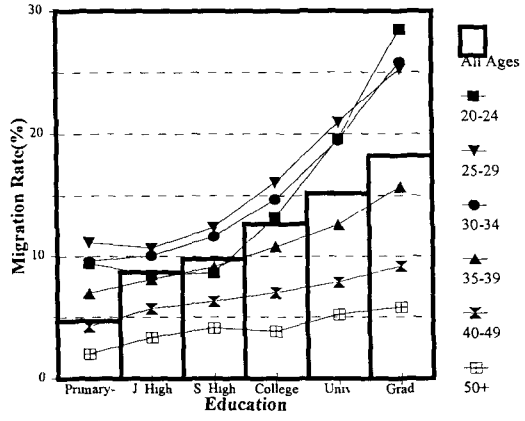
(B) Onward Migration



(C) Return Migration



(D) Overall Pattern



It is interesting to note that the effect of educational attainment was somewhat weaker on onward migration than on primary migration. Note that the substantial increase in the primary and onward migration rates for "all ages" from the primary to the junior high level of educational attainment should not be interpreted as an indication of a strong positive effect of educational attainment, because it was due to the fact that older adults were less migratory and more likely to have only primary education.

Similar to Long's (1988) finding about interstate return migration in the United States, return migration for most age groups was slightly selective of the less educated although its negative selectivity pattern was rather weak.(Figure 4.1: panel C). This finding suggests that the attraction of location-specific capital left in native domicile tended to be similar for individuals with different levels of education, and that the better educated were less likely to be disappointed by the outcome of previous migration. Also note that the increase in the return migration rate for "all ages" from the primary level to the junior high level of education also should not be interpreted as a positive effect of educational attainment, because it was simply a reflection of the fact that older people tended to be less migratory and were more likely to have only primary education.

Since return migrants represented only a small proportion of all interprefectural migrants and the effect of education on return migration tended to be rather unimportant, panel D of Figure 4.1 shows that the effects of educational attainment on the overall migration rates were quite similar to the effects on the primary and onward migration rates: positive in general, particularly strong on younger adults, and quite strong beyond the senior high level.

4.5.2 Impacts on the Prefectural Human Resources

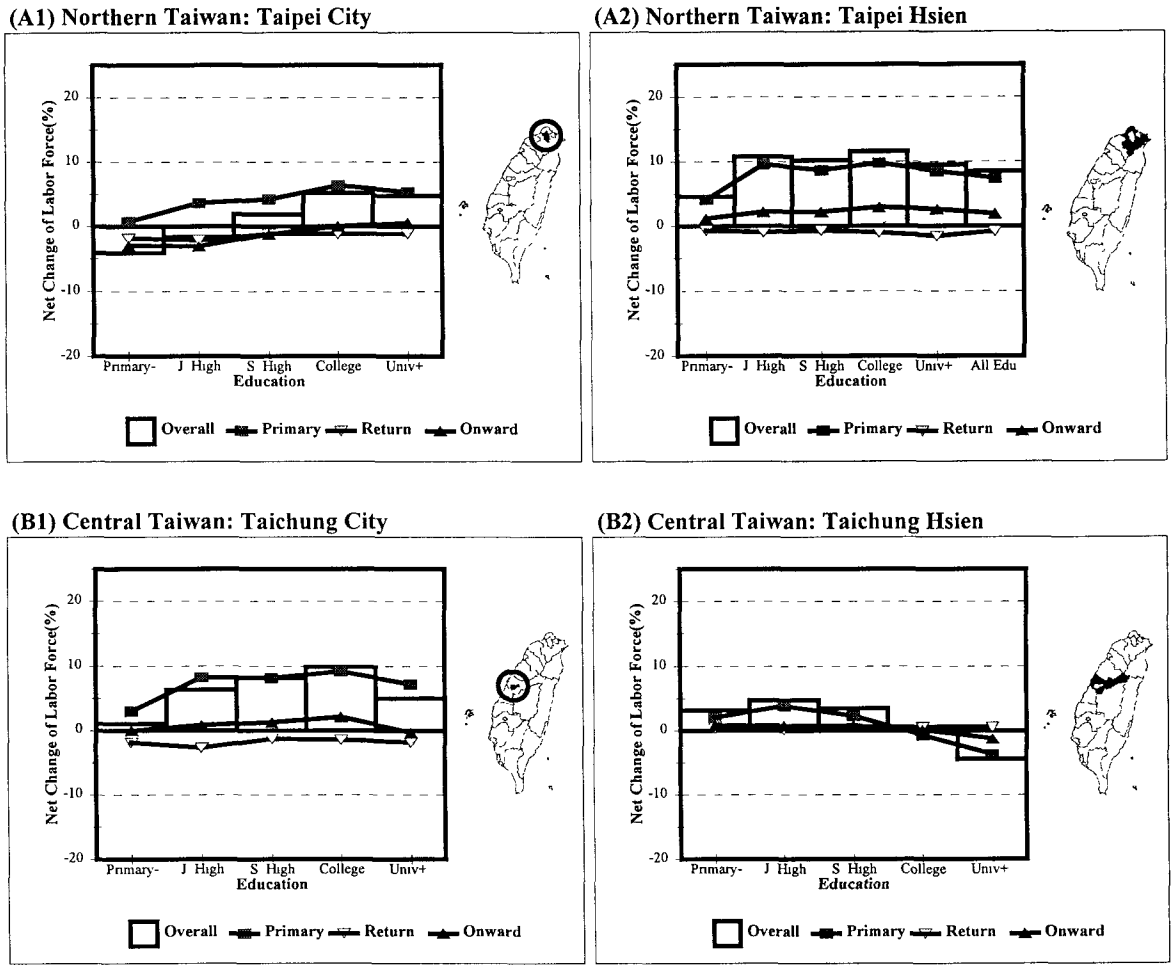
The strong positive educational selectivity of primary and onward migrations and the weak negative selectivity of return migrations, together with the domination of primary migration on return and onward migrations, suggest that prefectures with a large net gain of migrants tended to enjoy an improvement in the quality of human resources, whereas the prefectures with a large net loss of migrants tended to suffer a deterioration in the quality of these resources. However, these tendencies can vary substantially with the different roles played by different prefectures.

Metropolitan core prefectures: Being the capital and the location of many corporate headquarters, Taipei City had many high-skilled jobs that were attractive to the individuals who had relatively high levels of education and were able to pay for the city's high cost of living. As expected, Taipei City had positive overall net migration rates for those with senior high, college, and university levels of education and negative overall net migration rates for those with primary and junior high levels of education (Figure 4.2: panel A1). Its overall net migration rates ranged between about 5% for those with college and university education and -4% for those with primary education. Its net gains of the better educated migrants were almost due to primary migration, whereas its net losses of the less educated migrants were completely due to onward migration and return migration. Note that most of onward migrants and a large proportion of return migrants went to its neighboring suburban prefecture, Taipei Hsien.

In Taichung City, the core of the third largest metropolitan area, the overall net migration rates were positive at all levels of education. They were (1) particularly high at junior high level (6.3%), senior high level (8.1%), and college level (9.8%), (2) moderately

high at the university level (5.0%), and (3) nearly zero at primary level (1.0%) (Figure 4.2: panel B1). Compared with Taipei City, Taichung City distinguished itself by being very attractive to those with middle levels of education.

Figure 4.2. Impact of Inter-prefectural Migration of the Labor Force Aged 20+ (in 1990) on the Spatial Human Capital Stock by Type of Migration : Based on the 1990 Population Census, Taiwan.



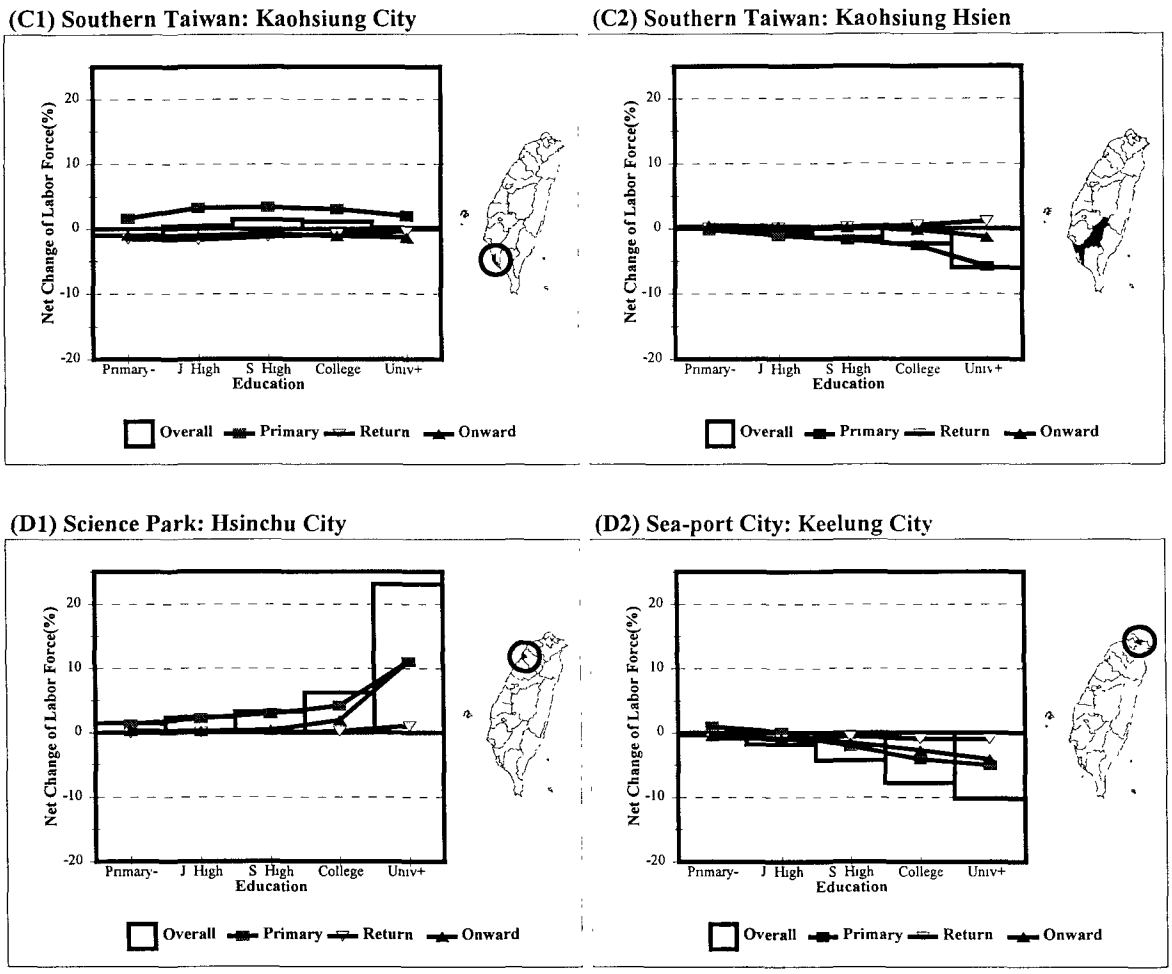
In Kaohsiung City, the core of the second largest metropolitan area and the largest seaport city, the overall net migration rates were nearly zero at all five levels of education. Somewhat visible gains were found at senior high and college levels (1.4% and 1.1%). At the primary level of education, there was a slight net loss (-1.0%) (Figure 4.2: panel C1). A common feature of all three core cities was that the overall net migration rate was the lowest at the primary level of education. This finding suggests that those with the least amount of education tended to have difficulties in finding jobs and paying for higher cost of living in these cities. Since those with the lowest level of education were relatively old, this finding also suggests that older adults tended to be less likely to migrate to the core cities of large metropolitan areas, a common feature observed in many other countries.

Suburban prefectures of metropolitan areas: In Taipei Hsien, the most attractive suburban prefecture, the overall net migration rates did not suggest either a positive or a negative educational selectivity. Except for a lower overall net migration rate (4.5%) at the primary level of education which was associated with more age effect than educational effect, the overall net migration rates stayed at a very high level of about 10% at all other levels of education (Figure 4.2: panel A2).[11] This finding partly reflects the fact that many of the well-off people in Taiwan prefer to live in the central cities, which are perceived of having no risk of degenerating into slums. It also reflects the fact that the suburban areas of the metropolitan areas in Taiwan typically include a large numbers of old towns and cities that have rather modest and densely packed houses, although there are a few suburban

[11] In Taoyuan Hsien, a more distant suburban prefecture of the Taipei metropolitan area, the overall net migration rates at all five levels of education were also positive. But, the net migration rate at the university level was the lowest, suggesting that the best educated were the least willing to commute over a long distance.

communities with expensive houses and large lots. The most important contributors to Taipei Hsien's large net gain were primary migrants at all levels of education from not only Taipei City but also many other prefectures.

Figure 4.2. Impact of Inter-prefectural Migration of the Labor Force Aged 20+ (in 1990) on the Spatial Human Capital Stock by Type of Migration : Based on the 1990 Population Census, Taiwan. ***(Cont.)***



In Taichung Hsien, a semi-rural suburban prefecture of the third largest metropolitan area, the net migration gains were limited to the three lower levels of education, with the overall net migration rates at these levels of education being between 3% and 5% (Figure 4.2: panel B2). On the other hand, it had a substantial net loss of migrants with university education (-4.5%).

In Kaohsiung Hsien, where the sites of traditional and petrochemical industries were rather polluted, the overall net migration rate was near zero at the lowest level of education and became increasingly negative at higher levels of education, reaching -6.0% at the university level (Figure 4.2: panel C2). An important general point is that in all suburban prefectures of the three metropolitan areas of Taiwan, there was no evidence of the typical selectivity in the North American suburbanization process: a large outflow of the upper class, leaving behind the lower class in the central cities.

Science City versus a stagnant seaport city: The success of the Science Park was clearly reflected by Hsinchu City's extremely high overall net of migration rate at the university level (23.1%), which was contributed as much by onward migrants as by primary migrants. The high-tech industries in the Science Park not only attracted a large number of engineers and other professionals, but also generated jobs for those with lower skills so that the city had a net gain of migrants at all levels of education (Figure 4.2: panel D1). In Keelung City, a stagnant port city, the overall net migration rates were greater at a higher level of education, reflecting the greater ability of the better educated natives and non-natives in the city to use migration as a way to adjust to the changing economic circumstances (Figure 4.2: panel D2). At the university level, the overall net migration rate was as negative as -10.2%, which was contributed almost as much by onward migrants as by primary

migrants. The main point demonstrated by Hsinchu and Keelung Cities is that labor migrations tended to adjust selectively and rapidly to recent changes in the relative economic fortunes of major cities.

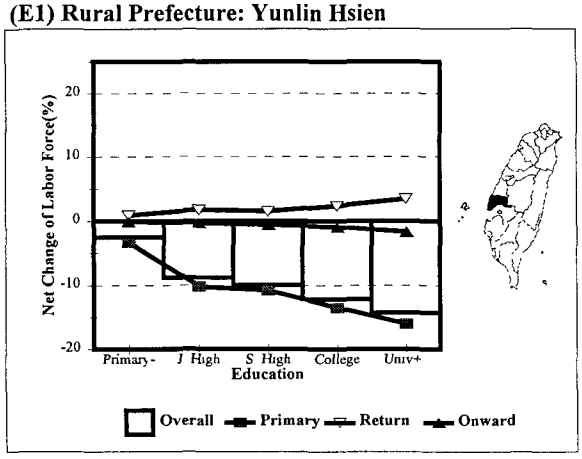
Rural/peripheral prefectures: In general, the overall net migration rates of rural/peripheral prefectures tended to be more negative at a higher level of education. Since natives represented a large proportion of these prefectures' labor force, it was the greater loss of primary migrants at a higher level of education that was the major cause of the deterioration in the quality of human resources in these prefectures. In Yulin and Hualien Hsiens, the overall net out-migration rates at the college and university levels were about 10% or even greater (Figure 4.2: panels E1 and E2). The most serious case was Chiayi Hsien, which had an overall net out-migration of 21.7% at the university level. It is important to note that the rural/peripheral prefectures' substantial decrease in the quantity and quality of labor due to migration might be compensated for in part by the ***rural-ward transfer of financial support*** from the central government and by the ***remittances*** sent back by the rural out-migrants, because they help improve agricultural productivity, infrastructure, and housing units in the rural prefectures. Most rural communities remain economically viable and are not in danger of becoming a ghost town.

In sum, our main findings about the selective effects of educational attainment are as follows. First, the prefectures that benefitted most in terms of the improvement in the quality of human resources were Taipei City, the political and economic command center of Taiwan, and Hsinchu City, the location of the highly successful Science Park. Second, unlike the suburbanization process in North America which typically involved a massive shift of the upper class to suburban areas, leaving behind the lower class in decaying central cities,

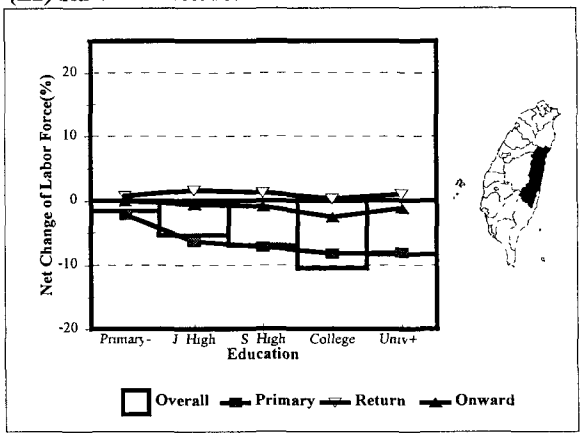
the net gains of migrants in the attractive suburban prefectures of Taiwan were not positively selective with respect to educational attainment so that labor migration did not help enhance the quality of human resources in suburban prefectures. Third, all rural/peripheral prefectures suffered a decline in both quantity and quality of labor through migration. Fourth, relative to return and onward migrations, primary migration played the dominant role in the selective impacts of educational attainment.

Figure 4.2. Impact of Inter-prefectural Migration of the Labor Force Aged 20+ (in 1990) on the Spatial Human Capital Stock by Type of Migration : Based on the 1990 Population Census, Taiwan. ***(Cont.)***

(E1) Rural Prefecture: Yunlin Hsien



(E2) Rural Prefecture: Hualien Hsien



4.6 Conclusion

Our analysis on the life-time and 1985-90 migration processes has revealed that labor migration in Taiwan has been extremely efficient: the main streams of migrants to North Region were much greater than the counter-streams, and primary migrations were much more voluminous than return and onward migrations.

The distinctive features of the officially-defined four regions of Taiwan have been revealed by our analysis. North Region was clearly a national labor market. It had an extremely strong power to attract the natives of all other regions and to retain its own natives. Central and South Regions were clearly regional labor markets. These two neighboring regions sent very few migrants to each other, although there were no physical barriers between them. Most of the jobs created in each of these two regions were taken by stayers and short-distance migrants. The least industrialized East Region was a net loser in the 1985-90 exchanges of migrants with any other region. Still, it had a rather high proportion of non-natives (23%) in its population, reflecting the fact that it had been an important settlement frontier up to the 1950s.

At the level of 23 prefectures, the 1985-90 migration patterns have revealed more complex pictures. First, rural/peripheral prefectures in all four regions had a typical pattern as "loser": a large net loss of primary migrants, countered by a small net gain of return migrants and somewhat aggravated by a small net loss of onward migrants. This implies the continuation of urbanization process and a trend towards a more concentrated settlement pattern. Second, the overall net migration rates of the three metropolitan core prefectures were quite different for different reasons: rather low for Taipei mainly because of a very strong suburbanization process; very high for Taichung partly because of a sudden housing

boom; and very low for Kaohsiung mainly because of its inability to restructure its economy. Third, North Region's massive net gain of migrants was accrued mainly by two suburban prefectures (Taipei Hsien and Taoyuan Hsien), which had large net gains of both primary and onward migrants and small net losses of return migrants. The massive expansion of northern economic pole was in sharp contrasts with the net loss of migrants in its southern counterparts (the Kaohsiung area). Fourth, the continuation of urbanization did not guarantee net gain of migrants in all major cities. With a weak or weakened economic base, two major cities (Chaiyi and Keelung) had net losses of all three types of migrants. Fifth, as a reflection of national economic policy, Hsinchu City benefitted substantially from the establishment of the country's first Science Park and had net gains of all three types of migrants.

With respect to the educational selectivity in the 1985-90 interprefectural migrations, the greatest beneficiaries were Taipei City (the command center of the internationalized Taiwanese economic system) and Hsinchu City (the so-called Taiwan's Silicon Valley). The main losers include not only all rural/peripheral prefectures but also the economically weakened major cities of Keelung and Chiayi. However, the losses in the quantity and quality of the human resources due to migration did not result in socioeconomic declines in rural/peripheral prefectures, because these losses were compensated for largely by the rural-ward financial transfer of the central government and partly by the remittances sent back by rural out-migrants. Finally, unlike the suburbanization process in North America which typically involved a massive shift of the upper class to suburban areas, leaving behind the lower class in the decaying central cities, the net gains of migrants in the attractive suburban prefectures of Taiwan were not positively selective with respect to educational attainment so that labor migration did not help enhance the quality of human resources in suburban prefectures and contribute to the decay of central cities.

Chapter 5

Primary Migration of the Taiwanese Young Labor Force in the Context of Economic Restructuring and Globalization: An Explanation Based on the 1990 Census

5.1 Introduction

Labor migration played an important role in Taiwan's transformation from a developing country to one of the NIEs (Newly Industrialized Economies) through the 1960s and 1970s. Massive rural-to-urban migrations, mostly migrations of the native-born rural residents, contributed to the rapid transfers of labor from the less productive primary sector to the more productive secondary and tertiary sectors, helping sustain a rapid economic growth. During this period, labor migration, together with the rapid expansion of export, facilitated the creations and expansions of both light and heavy industries. The net outflow rate from agricultural employment was about 6% per year through most of the years between 1965 and 1980 (Ishida 1988, pp. 61). Unlike rural-to-urban migrations in many other developing countries (especially those in Africa) which responded to very large urban/rural wage differentials and resulted in a serious urban unemployment problem (Todaro 1985), rural-to-urban migration in Taiwan helped prevent urban/rural wage differentials from becoming too large and keep both urban and rural unemployment rates at similarly low levels. Undoubtedly, labor migration had contributed to the successful industrialization and rapid economic growth of Taiwan.

The intensified labor migration through the 1960s and 1970s inevitably also resulted in some serious problems like pollution, congestion, and rising housing costs in major urban centers and the weakening of rural economic base. Various government policies, including the establishment of industrial districts throughout the whole country, were introduced to slow down labor migrations from less developed areas (Kao 1998). However, such policies seemed to have lost much of their importance by the 1980s when the strengthening of Taiwan's economy in the global market became a high priority.

For Taiwan, the 1980's was a period of economic restructuring and globalization. The economic restructuring was compelled by the sharp rise in the price of imported oil during the 1970's, by the steady increase in wage level, by the increasing unwillingness of workers to do unpleasant manual work, and by the increasing competitions from several industrializing countries . It was also facilitated by the substantial improvement in Taiwan's human capital through its extensive and relatively rigorous education system. It involved the expansions of high-tech industries (especially electronic industry) and the shrinkages of some traditional industries. The economic globalization was brought about by the significant expansion of Taiwan's export, the global trend toward free trade, and the liberalization of domestic financial market in Taiwan as well as in other countries, especially Taiwan's two major trade partners (the United States and Japan). It was also facilitated by the large accumulated trade surplus, the sharp appreciation of the Taiwanese currency, and the large surplus of domestic savings over domestic investment. It involved a rapid increase in the outflow of investment funds from Taiwan and the establishment of labor-intensive manufacturing plants in low-wage Asian countries by many Taiwanese companies (Gold 1986, pp. 97-102; Li 1988, pp. 209-236; Liu 1988, pp. 183; Tsay 1993).

The processes of economic restructuring and globalization can have differential and polarizing impacts on the economic prospects of different regions in Taiwan.[1] A region dominated by traditional manufacturing industries (e.g. Kaohsiung metropolitan area in southern Taiwan) can be expected to have relatively slow economic growth and to be relatively unattractive to well-educated labor. By contrast, a region with high-tech industries (e.g. Hsinchu City, Taiwan's Silicon Valley, on the southern fringe of Taipei metropolitan sphere) should have relatively rapid growth and be more attractive to the well-educated scientists and engineers. To serve the functions of financing, coordinating, and managing overseas productions, Taipei (capital of Taiwan) where the headquarters of many financial and manufacturing firms are located (e.g. see Selya 1995) can be expected to have an especially strong growth potential and to be particular attractive to the professionals and managers at the top of an occupational hierarchy. It may also be attractive to unkilled workers at the bottom of the hierarchy who serve the needs of these specialists. (Sassen 1988).

Our research interest lies in the study of interprefectural migration of young adult labor in the context of economic restructuring and globalization in Taiwan in 1985-90. Since the native-borns and non-natives tend to respond to the market forces in different manners

---

[1] The three largest cities are Taipei City, with 2.6 million people, in Northern Taiwan, Kaohsiung City, with 1.3 million people, in Southern Taiwan, and Taichung City, with 700,000 people, in Central Taiwan. Separated by huge mountain ranges, Eastern Taiwan does not have a major city and was a settlement frontier before the 1960's. The settlement system of Taiwan has a clear dual-pole pattern, with the northern pole being much larger than the southern pole in scale. The largest metropolitan sphere, including Taipei City, Taipei Hsien and Taoyuan Hsien, and Keelung City, has a population of 7.0 million, representing 36% of Taiwan's total population (19.7 million, averaged over 1985-90).

(Long 1988; Newbold and Liaw 1990),[2] this chapter will focus on primary migration (migration of the native-borns), leaving the study of return and onward migrations (migration of the non-natives) to a later chapter. The main reason for focusing on the segment of the young adult labor force lies in the fact that the young adults are at the most migratory ages of their life courses and hence have the greatest impact on redistributing the labor force and population in Taiwan. Since many migrations of those in the late teens and early 20s are largely due to the entries into and the exits from educational institutions and obligatory military service (only males), we limit the young adult labor force in the study to be in the 25-29 age group, defined as of 1990.

The organization of this chapter is as follows. Section 5.2 describes the data and a two-level nested logit model. Section 5.3 specifies the explanatory variables. Sections 5.4 and 5.5 report findings on the departure and destination choice models, respectively. Section 5.6 presents a concluding discussion. The detailed descriptions of explanatory variables in the model as well as the data sources are relegated to Appendix 5.1.

5.2 Data and Methodology

The data set for this chapter is a multidimensional tabulation of the full records of the

[2] In general, natives are less likely to migrate, because they are more prone to be tied down by the large amount of the location-specific capital in their current place of residence and have relatively little knowledge about the opportunities in the rest of the country. By contrast, non-natives are more likely to migrate again, because they tend to be more aware of the opportunities in the rest of the country (mainly as a consequence of their previous migration experience) and are subject to the drawing power of the large amount of location-specific capital in their native domicile (Morrison 1971; Da Vanzo 1981).

1990 Population Census of Taiwan.[3] The dimensions of this tabulation include native domicile, residence in 1985, and residence in 1990, as well as a set of demographic and economic attributes that are useful for studying migration selectivity. The geographical units of migration are the 7 major cities and 16 "hsiens" (similar to prefectures or states). For simplicity, these 23 units will be called "prefectures". For a given individual in the labor force, a migration is said to have occurred if the 1990 prefecture of residence is different from the 1985 prefecture of residence. An advantage of using prefectures rather than municipalities as the basic units of migration is that most of housing-related moves will not be counted as migrations, whereas the exclusion of individuals not in the labor force enables us to highlight the link between labor migration and market forces more clearly.

Although the 1990 census did not ask for information on the place of birth, it contains the information on the native domicile, which refers to the long-term base of an individual's family and is in most cases identical to her/his prefecture of birth in Taiwan.[4] Similar to the place of birth, the native domicile of a person is an important piece of information for the study of migration behavior, because it is a place where she/he tends to have a large amount of location-specific capital.

In this study, a "native" is defined as a person who resided in her/his prefecture of

---

[3] In Taiwan, all the households received the same census questionnaire. This is different from the recent censuses of Canada and the United States where only about 20% of the households received the so-called "long form" questionnaire which contains the migration questions. In this study, the labor force consists of employees, the unemployed, employers, and unpaid family workers.

[4] The so-called Chinese Mainlanders, who immigrated to Taiwan from Mainland China after World War Two, follow the convention of specifying their family roots as China-origin. Therefore, they and their descendants born in Taiwan are also excluded from the data.

native domicile in 1985, whereas a "non-native" is the person whose 1985 prefecture of residence differed from her/his prefecture of native domicile. The migration made by a native in 1985-90 is called a "primary migration", whereas the migration made by a non-native in 1985-90 is either a "return migration" (if the destination is the native domicile) or an "onward migration" (if the destination is not the native domicile). Since this chapter aims at the study of primary migration, the population in question of this analysis is thus restricted to the natives in the labor force aged 25-29 (in 1990).

To explain the migration behaviors of the native-born young labor force, we use a two-level nested logit model (Kanaroglou et al. 1986). At the upper level is the departure model which accounts for the probability of a native departing from her/his 1985 prefecture of native domicile. At the lower level is the destination choice model which accounts for a primary migrant's probability of choosing a specific destination from a set of potential destinations.

Departure model

Let $P_i(o)$ be the probability that a native i departs from her/his prefecture of native domicile o. The departure probability is formulated by a binary logit model:

$$(1) \qquad P_i(o) = \frac{exp(V_{oi})}{1 + exp(V_{oi})}, \quad V_{oi} = B_a + B_b X_{oi} + B_c I_{oi};$$

where V_{oi} represents the difference in attractiveness between the rest of the country and prefecture o perceived by the native i; B_a is an unknown coefficient; B_b is a row vector of unknown coefficients in association with X_{oi}, which is a column vector of observable explanatory variables (the personal characteristics of potential migrant i and the

socioeconomic attributes of prefecture o as well as their interactions); B_c is the coefficient of the so-called inclusive variable $I_{o\,i}$, which represents the attractiveness of the rest of Taiwan perceived by the native i. Note that B_c is theoretically bounded between 0 and 1 and the inclusive variable is to be defined later in equation (3).

Destination choice model

Given that the native i departs from the prefecture of native domicile o, her/his probability of choosing destination d from the choice set D (the set of all possible destinations), $P_i(d)$, is formulated by a multinominal logit model:

$$(2) \qquad P_i(d) = \frac{exp(V_{d\,i})}{\sum_{d' \in D} exp(V_{d'\,i})} \quad , \quad V_{d\,i} = B_d X_{di} \quad , \quad d \in D \; ;$$

where $V_{d\,i}$ represents the attractiveness of destination d perceived by migrant i; B_d is a row vector of unknown coefficients; and $X_{d\,i}$ is a column vector of observable explanatory variables. The inclusive variable is defined as

$$(3) \qquad I_{o\,i} = Log\,(\sum_{d' \in D} exp(V_{d'\,i})) \; .$$

Estimation method and the assessment of explanatory power

The unknown coefficients are estimated by the maximum quasi-likelihood (MQL) method through the Newton-Raphson algorithm (McCullagh 1983; Liaw and Ledent 1987). The estimation is done sequentially as follows: the coefficients in the destination choice model are first estimated and then used to compute the values of the inclusive variable; with the inclusive variable being incorporated into the departure model as one of the explanatory variables, we then continue to estimate the coefficients of the departure model. Since the

number of observations in the model is very large[5], the MQL estimators of the unknown coefficients can be considered as being normally distributed, and the t-ratio of an estimated coefficient (i.e. the estimated coefficient divided by the corresponding asymptotic standard error) with a magnitude of more than 1.96 can be viewed as statistically significant.

The goodness-of-fit for a given specification of the model is measured by the Rho-square statistic defined as $\rho^2 = 1 - L / L_o$, where L is the maximum logarithm of quasi-likelihood of the specification in question, and L_o is the maximum logarithm of quasi-likelihood of the null model (i.e. the model with the coefficients of all explanatory variables set to zero). Although this statistic is theoretically bounded between 0 and 1, its ceiling is empirically much less than one so that a value of 0.2 can represent a very good fit (McFadden, 1974).

The "best model" in this chapter refers to the model with all coefficients being substantively sensible and statistically significant. To assess the relative explanatory powers of two subsets of explanatory variables in the best model, each subset is deleted in turn from the best model and then compare the resulting *changes in Rho-square* defined as $\rho^2 - \rho^2(R)$, where ρ^2 and $\rho^2(R)$ are the corresponding Rho-square of the best model and the reduced model, respectively. The assessment principle is: the greater the change, the more important the deleted subset of explanatory variables. However, since the changes in Rho-square do not take into account of the information of degree of freedom, we will consider two deleted subsets of explanatory variables as similarly important if the corresponding changes in Rho-

---

[5] In the departure model, there are 68,219 observations representing 836,488 Taiwanese natives aged 25-29 in the labor force. In the destination choice model, there are 35,853 bundles of 22 observations (corresponding to 22 potential destinations), representing 85,529 primary migrants.

square are not very different.[6]

5.3 Specification of the Explanatory Variables

We use two types of explanatory variables: (1) the micro-level personal factors and (2) the macro-level ecological variables. The personal factors refer to the characteristics of the natives in the departure model and of the primary migrants in the destination choice model, whereas the ecological variables represent respectively the socioeconomic characteristics of the origins in the departure model and of the potential destinations in the destination choice model. In other words, the personal factors represent the attributes of the choice-makers, whereas the ecological variables represent the attributes of the choice set. To improve readability, the detailed definitions of the explanatory variables are described in Appendix 5.1.

The chosen personal factors are: (1) ***gender*** (male and female), (2) ***marital status*** (single, married, divorced/separated, and widowed), (3) ***educational attainment*** (primary, junior high, senior high, college, and university), (4) ***breadwinner status*** (breadwinner and

---

[6] The change in Rho-square is statistically equivalent to $2*(L - L(R))$, where L is the maximum logarithm of quasi-likelihood of the best model and $L(R)$ the maximum logarithm of quasi-likelihood of the reduced model. The statistic $2*(L - L(R))$ has an asymptotic Chi-square distribution, with the degrees of freedom being equal to the number of deleted explanatory variables, and can be used to compute the corresponding p-value. In principle, the p-value is better than the change in Rho-square in terms of assessing the relative importance of a deleted subset of explanatory variables, because the p-value incorporates the information of the degrees of freedom. However, the function used to compute the p-value in most computing softwares (e.g. SAS and Quattro) will yield a 0, when the Chi-square is quite large. Thus, when several Chi-squares are quite large, the corresponding p-values are all artificially set to 0 and can not be used to tell which of the deleted subsets is more important.

non-breadwinner), (5) ***industry*** (agricultural, industrial, and service)[7], and (6) ***occupation*** (professional, managerial, agricultural, low-skilled, and other). These factors are all represented by dummy variables. The use of personal factors and their interactions with the ecological variables is to achieve a good grasp of migration selectivity. Note that for both substantive and methodological reasons, the dummy variables representing personal factors can enter the destination choice model only as interactions with an ecological variable.

A set of ecological variables are used to capture market effects. The directly measured employment variables include (1) ***non-agricultural share of total employment***, (2) ***employment growth rate***, (3) ***unemployment rate***, and (4) ***income level*** represented by household income. The variable of (5) ***prefectural government expenditure per capita*** is also incorporated as a labor market variable, because it is a good measure for the level of job opportunities created by the public sector.

The status of Taipei City as a the command center of the globalizing Taiwanese economy is represented by a dummy variable called ***World City***. Since a World City tends to be particularly attractive to the highly skilled individuals, this dummy variable is expected to have (1) positive interactions with the dummy variables representing the better educated individuals in the destination choice model and (2) negative interactions with these variables in the departure model. Because many people who work in Taipei City tend to live in its neighboring prefecture, the World City effects may be partly reflected in the migration pattern of Taipei Hsien. Thus, a dummy variable called ***World City Suburban*** is used to

---

[7] The terms "agricultural, industrial, and service" are used in this chapter as more descriptive terms for "primary, secondary, and tertiary", respectively. Note that most employment in the primary sector is in agriculture.

represent Taipei Hsien.

Hsinchu City, which contains a large ***Science Park*** that received substantial investment funds for developing high-tech industries under the active promotions of the central government through the 1980's, is represented by a dummy variable to control for the effect of economic restructuring. The rapid expansion of high-tech industries in the Science Park of Hsinchu City through the 1980's may result in (1) a strong negative interaction between the dummy variable representing Hsinchu City and the dummy variable representing the university-educated individuals and (2) a strong positive interaction between these variables in the destination choice model.

It is also important to consider the potential effects of the strong ***patriarchal value system*** in the Taiwanese society on migration behaviors (Hsiung 1996). Being expected to be subordinate to their husbands and to be responsible for all aspects of house-keeping, female young adults in this society may be much less sensitive to the labor market conditions in their migration behaviors and be much more likely to migrate as a consequence of a change in marital status than their male counterparts. Furthermore, it is also expected that the breadwinners in this society (mostly males) are more prone to use migration as a means to improve their households' economic well-being and are particularly sensitive to the pushes and pulls of market forces. Thus, in addition to the dummy variables representing gender, marital status, and breadwinner status in the departure model, we also use the interaction terms between these dummy variables and the labor market variables in both departure and destination choice models.

In addition, we also incorporate the variables of ***population density***, ***housing growth***,

and ***housing cost*** to control for the effects of housing conditions and quality of life. ***Distance*** and ***contiguity*** between prefectures are used to control for the effects of relative location, whereas prefectural ***population size*** is used to control for the effect of the size of ecumene (economic scale). Note that some explanatory variables are log-transformed in order to achieve better goodness of fit.

5.4 Estimation Results of the Departure Model

The estimation of the departure model is based on the 68,219 observations representing 836,488 young native adults in the labor force. The estimated coefficients and the corresponding t-ratios of the best departure model are shown in Table 5.1, with the observed and predicted departure rates by a set of explanatory variables being summarized in Table 5.2. The data reveal that the overall departure rate was 10.2%, and the prefecture-specific departure rates tended to decrease with the level of urbanization: 6.8% for the most urbanized prefectures, 9.0% for other major cities, and 11.8% for rural prefectures (Table 5.2).

As shown in Table 5.1, the estimation results of the best departure model lend support to some expected effects of economic restructuring and globalization on the departure propensities. Although the positive coefficient of World City (0.505) suggests that the residents of Taipei City were in general more prone to out-migrate, mostly to its suburban prefectures, this tendency was close to zero for those with college education (0.505 - 0.454) and became reversed for those with university education (0.505 - 0.850). Playing the role of World City in the globalizing economy, Taipei City indeed had a strong retention effect on the best educated young native adults. The negative coefficient of Science Park (-0.656) indicates that Hsinchu City had a retention effect on all types of young adult workers. This

retention effect for Hsinchu City might be related not only to the rapid expansion of high-tech industry, but also to its multiplier effects.

Closely related the development of economic restructuring and globalization in the 1980s, the positive effect of educational attainment, similar to the patterns found in North America (Long 1988; Liaw 1990; Liaw and Frey 1996), on the young native adults' migration propensities turned out to be very strong. The estimated coefficients in the best departure model indicate that the departure propensities increased with educational attainment, with the increase being particularly large toward the college and university levels. This multivariate finding is very consistent with the observed pattern of departure rates by education level (about 8% for primary and junior high, 10% for senior high, 14% for college, and 18% for university education), confirming the idea that the young native adults with better education tended to have more and better information about the opportunities in different prefectures and were hence more migratory.

The departure propensities of the natives were seen to vary systematically with their categories of industry. The large negative coefficient of Agricultural Worker (-0.93) indicated that agricultural workers tended to be much more sedentary than non-agricultural workers, mainly because the former were more likely to be tied up by their location-specific capital (e.g. farmland). This difference is well reflected by the observed departure rates: only 1.9% for agricultural workers, 10.8% for industrial workers, and 13.5% for service workers (Table 5.2).

Table 5.1. Estimation Results of the Departure Model for the Native-born Labor Force Aged 25-29 : Based on the 1990 Population Census, Taiwan.

Explanatory Variable	The Best Model		Change in
	Coefficient	t-ratio	Rho-square
Constant Term	-4.577	-14.9	
I. Personal Attributes			
1. Effects of Marital Status and Sex(Refe.: All Others)			0.0261
Married	0.293	8.0	
Married*Female	1.091	20.6	
Divorced/Seperated*Female	0.486	2.8	
2. Effects of Education(Refe.: At-most Primary Schooling)			0.0117
Junior High	0.138	2.4	
Senior High	0.326	5.8	
College	0.769	12.2	
University	1.182	17.2	
3. Effect of Breadwinner Status(Refe.: Non-breadwinner)			0.0026
Breadwinner	2.644	10.8	
4. Effect of Industry (Refe.: Non-agricultural Worker)			0.0008
Agricultural Worker	-0.934	-5.5	
II. Ecological Variables and Interaction Terms			
1. Effect of Size of Ecumene			0.0025
Ln(Population Size)	-0.334	-10.8	
2. Effect of Quality of Life			0.0011
Population Density	0.083	7.2	
3. Effects of Labor Market Variables			0.0212
Effects of Employment Structure			
Ln(Non-Agri. Share of Total Employment)	-2.203	-14.5	
Ln(Non-Agri. Share of Total Employment)*Agricultural Worker	3.331	7.2	
Effects of Employment Growth			
Employment Growth	-0.145	-5.2	
Employment Growth*Female	0.141	6.2	
Employment Growth*Breadwinner	-0.108	-4.6	
Employment Growth*Low-skilled Labor	-0.073	-3.8	
Effects of Unemployment			
Rural Unemployment Rate*Breadwinner	0.125	3.5	
Effect of Local Finance			
Local Government Expenditure Per Capita*Service Sector Worker	-0.532	-7.9	
Effect of Household Income			
Household Income*Breadwinner	-0.293	-5.6	
4. Effects of World City			0.0007
World City	0.505	3.8	
World City*College	-0.454	-3.1	
World City*University	-0.850	-5.0	
5. Effect of Science Park			0.0005
Science Park	-0.656	-4.6	
6. Effect of the Attractiveness of the Rest of the System			0.0001
Inclusive Variable	0.105	2.4	
Rho-square	0.1545		

The negative coefficient of the logarithm of the Non-agricultural Sector's Share of Total Employment, the most important labor market variable in the model, suggests that prefecture with a higher proportion of employment in the non-agricultural sector was much more capable of retaining the native young adults. However, the positive coefficient of the interaction between this variable and Agricultural Worker indicates that agricultural workers were more likely to be pushed out of the highly urbanized prefectures than non-agricultural workers, mostly because of the shortage of agricultural jobs. Thus, the similarity between a prefecture's employment structure and an individual's category of industry turned out to be a crucial determinant of the departure propensity.

Another important finding revealed by the best departure model is that low-skilled laborers, especially the male ones, were rather sensitive to the retention effect of a relatively high employment growth rate, suggesting that getting jobs rather than achieving high income was the major consideration of low-skilled laborers.[8] Also, the negative coefficient of the interaction between Government Expenditure Per Capita and Service Worker suggests that the prefectures that spent more money to create more service jobs were more capable of retaining the young native workers in the service sector.

However, in addition to the economic factors, the joint effects of sex and marital status suggest that the departure behaviors of the young native adults were also strongly influenced by the patriarchal value system of the Taiwanese society. Before interpreting their effects, one must bear in mind that those young adults reported as being married or

---

[8] The coefficients of employment growth rate are -0.218 (sum of -0.145 and -0.073) for low-skilled males and -0.326 (sum of -0.145, -0.108 and -0.073) for low-skilled male breadwinners.

divorced/separated or widowed in 1990 census had most likely experienced ***the change in marital status*** during 1985-90, causing them (especially the females) to be more migratory than singles. Although the census questionnaire did not ask for information on the age at first marriage, it is reasonable to assume that most of the young natives whose marital status was reported as "married" on the census date got married during the 1985-90 period. Thus, it is reasonable to see that the estimated coefficient in the best departure model turns out to be positive for Married (0.293) and very positive for Married*Female (1.091). The positive coefficient of Divorced/Separated*Female (0.486) also suggests that a marriage breakup tended to compel the female partner to out-migrate.

In addition to affecting the departure behaviors induced by the change in marital status, the patriarchal ideology also affected the natives' sensitivity to the market forces of origin. As suggested by the best departure model, breadwinners (mostly males) and females behaved quite differently in their sensitivity to the conventional labor market variables, although female young native adults were slightly more migratory than their male counterparts. The coefficient of Breadwinner in the best departure model turned out to be extremely large (2.644), suggesting that the strong economic responsibility assigned by the norm of the patriarchal society on breadwinners resulted in their very strong propensities to use migration as a means of improving household economic well-being.[9] The contrast between the observed departure rates for breadwinner (18.0%) and for non-breadwinner (7.3%) also lends support to this multivariate finding (Table 5.2). The estimated coefficients also show that among all the sub-populations, breadwinners were more likely (1) to be

[9] Because the status of breadwinner was measured at the time of census, breadwinners' strong response to the market forces might be in part induced by a status change from non-breadwinner to breadwinner in 1985-90.

retained by a relatively high employment growth rate and a relatively high income level, and (2) to be subject to the push effect of rural unemployment level. In sharp contrast to breadwinners, the departure propensities of most females turned out to be insensitive to the above-mentioned labor market variables, reflecting the norm of a patriarchal society that the pursuit of occupational career was more the secondary than the primary goal for females.[10]

As a proxy for the size of ecumene, population size of origin exhibited the expected retention effect. With respect to the indicators of housing conditions and quality of life, the best departure model only reveals the push effect of high population density, with the effects of housing cost and housing growth being insignificant. Note that the insignificant effects of housing cost and housing growth might be due to the facts (1) that the natives tended to have more location-specific capital (e.g., house ownership) than non-natives and (2) that many young adult natives were still co-residing with their parents.

The inclusive variable, which represents the attractiveness of the rest of the system, turned out to have a small positive coefficient (0.105) and a relatively weak explanatory power in the best departure model. This result suggests that the interprefectural variation in departure propensity was mainly determined by the variations in the demographic and economic compositions of the natives and by the variations in the socioeconomic attributes of origin prefectures.

---

[10] The effect of employment growth rate on the departure propensity of the female labor force who were not in the low-skilled category is represented by a very small coefficient of -0.004 (the sum of -0.145 and 0.141), whereas the coefficient for the females who were in the low-skilled category is -0.077 (the sum of -0.145, 0.141, and -0.073). In comparison, the corresponding value for breadwinners is -0.253.

Table 5.2. The Observed and Predicted Numbers of Migrants and Departure Rates for the Native-born Labor Force Aged 25-29 by Sex and Marital Status, Education, Breadwinner Status, Industry, Occupation, and Origin : Based on the 1990 Population Census, Taiwan.

	At-risk Population		Number of Migrants		Departure Rate	
	Volume (Persons)	Composition (%)	Observed (Persons)	Predicted	Observed (%)	Predicted
Total	836,488	100.0	85,529	85,529	10.2	10.2
1. Marital Status						
Single	441,938	52.8	30,522	30,470	6.9	6.9
Married	383,813	45.9	53,923	53,923	14.0	14.0
Div/Sep	9,075	1.1	910	964	10.0	10.6
Widowed	1,662	0.2	174	172	10.5	10.3
2. Male Marital Status						
Single	310,672	54.4	20,554	20,514	6.6	6.6
Married	254,740	44.6	30,207	30,207	11.9	11.9
Div/Sep	4,971	0.9	335	389	6.7	7.8
Widowed	490	0.1	42	42	8.6	8.6
3. Female Marital Status						
Single	131,266	49.4	9,968	9,955	7.6	7.6
Married	129,073	48.6	23,716	23,716	18.4	18.4
Div/Sep	4,104	1.5	575	575	14.0	14.0
Widowed	1,172	0.4	132	130	11.3	11.1
4. Education						
Primary	70,564	8.4	5,873	5,873	8.3	8.3
Junior High	267,335	32.0	21,653	21,653	8.1	8.1
Senior High	329,851	39.4	32,716	32,716	9 9	9.9
College	109,545	13.1	14,855	14,855	13.6	13.6
At-least University	59,193	7.1	10,432	10,432	17.6	17.6
5. Breadwinner Status						
Breadwinner	226,506	27.1	40,754	40,754	18.0	18.0
Non-breadwinner	609,982	72.9	44,775	44,775	7.3	7.3
6. Industry						
Primary	139,231	17.0	2,665	2,665	1.9	1.9
Secondary	356,853	43.7	38,660	38,241	10.8	10.7
Tertiary	321,355	39.3	43,408	43,139	13.5	13.4
7. Occupation						
Professional	70,530	8.8	11,779	10,966	16 7	15.5
Managerial	3,746	0.5	574	509	15.3	13.6
Low-skilled	130,648	16.4	12,231	13,039	9.4	10.0
Others	594,003	74.4	56,980	57,028	9.6	9.6
8. Origin*						
Most Urbanized Areas	228,605	27.3	15,495	15,465	6.8	6.8
Other Major Cities	59,570	7.1	5,128	5,370	8.6	9.0
Rural Prefectures	548,313	65.5	64,906	64,696	11.8	11.8

* The most urbanized areas include Taipei city, Taipei Hsien, and Taoyuan Hsien of northern Taiwan, Taichung city of central Taiwan, and Kaohsiung city of southern Taiwan. Other major cities are cities of Keelung, Hsinchu, Chiayi, Tainan. Rural prefectures refer to prefectures excluding those in the above two categories.

Although the Rho-square of the best model (0.1545) looks smallish, the model has yielded predicted departure rates that turned out to be nearly identical to the corresponding observed departure rates for most sub-populations (Table 5.2). The changes in Rho-square in Table 5.1 indicate that sex and marital status, educational attainment, and breadwinner status, together with their interactions with labor market variables, account for much of the variation in the departure behaviors.

5.5 Estimation Results of the Destination Choice Model

Based on the records of 85,529 young primary migrants in the labor force, the estimation results of the destination choice model are summarized in Table 5.3. With a large Rho-square of 0.2900, the best destination choice model has explained the observed destination choice behaviors quite well. As indicated by Table 5.4, several patterns in the observed destination choice proportions of the primary migrants have been well predicted by the best model. In general, the destination choice behaviors were strongly oriented towards northern Taiwan, the attraction of which was greatly enhanced by the economic restructuring and globalization in the 1980s. As a whole, about 67% of the migration flows ended up in northern Taiwan, 18% in central Taiwan, 13% in southern Taiwan, and only 2% in eastern Taiwan.

According to the best destination choice model, there were three basic contrasts in the young primary migrants' selective response to the labor market variables of destination. The first contrast was between the destination choice behaviors of breadwinners and females. As a reflection of the influence of the patriarchal value system, employment growth rate at a potential destination had a strong attraction to breadwinners, but had nearly no effect on all female migrants except for those who were in the low-skilled category.

Table 5.3. Estimation Results of the Destination Choice Model for the Primary Migrants in the Labor Force Aged 25-29: Based on the 1990 Population Census, Taiwan.

Explanatory Variable	The Best Model		Change in
	Coefficient	t-ratio	Rho-square
1. Effects of Relative Location			0.0668
Ln(Distance to Potential Destination)	-0.705	-57.4	
Ln(Distance to Potential Destination)*At-least College	0.145	9.3	
Contiguity	0.118	3.6	
Contiguity*Married	0.311	9.5	
2. Effect of the Size of Ecumene			0.0165
Ln(Population Size)	1.361	43.0	
3. Effects of Quality of Life			0.0064
Population Density	-0.184	-15.5	
Housing Growth*Married	0.405	12.6	
Ln(Housing Cost)	-1.426	-11.7	
4. Effects of Labor Market Variables			0.0202
Effects of Employment Structure			
Ln(Non-agri. Share of Total Employment)	4.637	28.7	
Ln(Non-agri. Share of Total Employment)*Agricultural Worker	-4.943	-20.5	
Ln(Non-agri. Share of Total Employment)*Service Sector Worker	1.377	8.7	
Effects of Employment Growth			
Employment Growth	0.339	15.3	
Employment Growth*Female	-0.341	-17.5	
Employment Growth*Breadwinner	0.070	6.3	
Employment Growth*Low-skilled Labor	0.077	5.6	
Effect of Unemployment			
Unemployment Rate*Low-skilled Labor	-0.282	-8.0	
Effects of Local Finance			
Local Government Expenditure Per Capita	0.682	8.8	
Local Government Expenditure Per Capita*Service Sector Worker	0.648	23.4	
Effects of Household Income Differential			
Household Income Differential*University	0.010	2.1	
5 Effects of World City			0.0017
World City	0.285	3.8	
World City*College	0.563	13.2	
World City*University	0.832	9.4	
6 Effects of World City Suburban			0.0011
World City Suburban	0.200	3.2	
World City Suburban*College	0.390	7.0	
World City Suburban*University	0.384	11.5	
7 Effects of Science Park			0.0017
Science Park	0.144	2.1	
Science Park*College	0.583	5.1	
Science Park*University	1.524	14.3	
Rho-square	0.2900		

The second contrast was between the agricultural and non-agricultural migrants. The coefficients of the logarithm of non-agricultural share of total employment (4.637) and its interaction terms with Agricultural Worker (-4.943) and Service Worker (1.377) indicate (1) that the young primary migrants, particularly those in the service sector, had a very strong preference for prefectures with more non-agricultural employment, and (2) that the migrants of agricultural sector tended to avoid choosing the more urbanized prefectures, suggesting the level of similarity between the employment structure of destination and the type of an individual's economic activity was crucial to migrants in destination choice. Note that the variable of Employment Structure had the strongest explanatory power among the four labor market variables in the best model. Thus, this finding is highly consistent with the view that migration is a form of human capital investment.

The third contrast is between the low-skilled and university-educated (mostly professional and managerial) young primary migrants: the former were strongly affected by the positive effect of employment growth and the negative effect of unemployment rate, whereas the latter were more responsive to prefectural income level.[11] Thus, the major concern of the low-skilled young primary migrants turned out to be the availability of job opportunities, whereas the best educated migrants were more concerned with the income level at potential destination.[12]

---

[11] Note that the small t-ratio associated with Household Income Differential*University (t = 2.1) is partly due to the positive correlation between both variables of income level and local government expenditure per capita.

[12] The explanatory power of income level in the best destination choice model is rather weak. This is partly due to its overlap with the variables of Employment Structure, Local Finance and World City. For example, the t-ratio associated with Household Income Differential*University is increased from 2.1 to 5.1 when Employment Structure is deleted,

Table 5.4. The Observed and Predicted Destination Choice Proportions of the Primary In-migrants in the Labor Force Aged 25-29 by Marital Status and Sex, Education, Breadwinner Status, Industry, and Occupation : Based on the 1990 Population Census, Taiwan.

In-migrants			Destination Choice Proprotion of In-migrants (%)								
Personal Characteristics	Volume (Persons)	Composition (%)	Northern Taiwan			Central Taiwan		Southern Taiwan		Other Major Cities	Rural Pref.s
			Taipei City	Taipei Hsien	Hsinchu City	Taichung City	Taichung Hsien	Kaohsiung City	Kaohsiung Hsien		
			(Observed)								
Total	85,529	100 0	18 9	29 5	2 0	7 0	7 1	6 8	3 7	14 2	10 8
1. Male											
Single	20,554	40 2	23 5	31 9	2 2	6 8	6 4	6 2	3 0	12 6	7 4
Married	30,207	59 1	11 9	32 2	1 6	7 3	9 0	7 5	4 3	15 7	10 5
Div/Sep	335	0 7	15 8	29 9	1 5	4 5	9 0	6 6	3 3	15 8	13 7
Widowed	42	0 1	9 5	31 0	0 0	7 1	16 7	0 0	2 4	14 3	19 0
2. Female											
Single	9,968	29 0	37 9	25 6	2 3	7 5	3 9	5 2	2 4	9 5	5 8
Married	23,716	69 0	16 0	25 8	2 3	6 6	6 5	7 1	4 0	15 5	16 2
Div/Sep	575	1 7	17 0	22 4	0 9	9 2	6 3	7 3	5 0	17 2	14 6
Widowed	132	0 4	11 4	23 5	0 0	6 1	3 8	3 8	1 5	22 7	27 3
3. Education											
Primary	5,873	6 9	8 6	34 2	0 9	5 1	10 0	5 8	4 5	16 0	15 0
Junior High	21,653	25 3	11 2	35 4	1 2	6 3	8 9	6 1	3 6	16 0	11 3
Senior High	32,716	38 3	17 9	28 6	1 5	7 5	7 2	7 8	4 1	14 7	10 8
College	14,855	17 4	25 8	25 8	2 3	7 7	5 2	7 1	3 6	12 6	9 9
At-least University	10,432	12 2	34 1	22 6	5 3	7 1	4 0	5 4	2 2	10 4	8 9
4. Breadwinner Status											
Breadwinner	40,754	47 6	16 6	30 8	1 8	7 6	8 1	7 5	3 9	14 5	9 4
Non-breadwinner	44,775	52 4	21 0	28 3	2 2	6 5	6 2	6 2	3 5	14 0	12 1
5. Industry											
Primary	2,665	3 1	5 4	13 7	1 1	6 3	9 7	7 9	6 1	15 9	33 9
Secondary	38,660	45 6	12 5	34 2	2 2	5 6	8 9	5 8	3 7	16 9	10 2
Tertiary	43,408	51 2	25 3	26 4	1 9	8 3	5 4	7 6	3 5	11 7	9 9
6. Occupation											
Professional	11,779	14 4	24 3	23 5	5 2	6 9	4 9	7 0	3 2	13 2	11 7
Managerial	574	0 7	27 4	25 3	2 6	7 0	8 4	3 0	3 3	12 4	10 8
Low-skilled	12,231	15 0	8 1	38 9	0 8	5 6	9 3	5 3	3 8	17 0	11 1
Others	56,980	69 9	19 5	28 9	1 6	7 2	7 0	7 2	3 8	13 9	10 8
*7. Origin**											
Most Urbanized Areas	15,495	18 1	22 7	32 5	2 5	2 7	7 3	1 9	6 7	13 2	10 6
Other Major Cities	5,128	6 0	29 0	22 9	1 7	3 9	2 7	5 6	2 5	7 5	24 1
Rural Prefectures	64,906	75 9	17 2	29 3	1 9	8 3	7 4	8 1	3 1	15 0	9 8
			(Predicted)								
Total	85,529	100 0	18 9	29 5	2 0	7 2	5 9	6 8	4 9	13 2	11 5
1. Male											
Single	20,554	40 2	19 3	31 7	2 1	7 6	5 8	6 5	4 4	13 4	9 3
Married	30,207	59 1	15 5	31 4	1 7	7 9	7 1	7 0	5 4	13 9	10 2
Div/Sep	335	0 7	15 6	34 6	1 3	7 6	6 2	6 9	4 6	13 5	9 7
Widowed	42	0 1	13 9	31 9	1 5	7 7	7 4	5 4	5 8	13 1	13 3
2. Female											
Single	9,968	29 0	24 9	25 8	2 4	6 4	4 4	6 9	4 3	12 3	12 6
Married	23,716	69 0	20 5	26 5	2 2	6 5	5 3	6 7	5 1	12 6	14 7
Div/Sep	575	1 7	19 0	31 2	1 4	5 7	4 6	7 3	5 0	12 7	13 1
Widowed	132	0 4	20 9	32 0	1 5	6 6	4 3	6 3	4 3	12 1	11 9
3. Education											
Primary	5,873	6 9	12 6	34 2	1 1	6 1	6 4	6 9	5 6	13 1	14 1
Junior High	21,653	25 3	12 5	35 4	1 2	7 1	6 7	6 4	5 2	13 4	12 0
Senior High	32,716	38 3	16 3	28 5	1 5	7 9	6 3	7 6	5 4	14 4	12 2
College	14,855	17 4	25 8	26 2	2 3	7 0	5 1	6 2	4 3	12 5	10 6
At-least University	10,432	12 2	34 1	22 6	5 3	6 5	4 0	5 5	3 4	10 1	8 4
4. Breadwinner Status											
Breadwinner	40,754	47 6	17 4	31 2	1 8	7 6	6 5	6 9	5 0	13 5	10 1
Non-breadwinner	44,775	52 4	20 3	28 0	2 2	6 9	5 5	6 6	4 8	12 9	12 8
5. Industry											
Primary	2,665	3 1	6 1	19 8	1 0	4 9	9 5	3 9	9 7	11 9	33 2
Secondary	38,660	45 6	12 4	33 9	1 8	6 4	7 2	5 7	5 5	14 8	12 2
Tertiary	43,408	51 2	25 6	26 1	2 2	8 1	4 6	8 0	4 1	11 8	9 6
6 Occupation											
Professional	11,779	14 4	27 4	24 1	3 4	7 2	4 7	6 6	4 3	11 8	10 5
Managerial	574	0 7	19 1	30 8	2 4	7 0	6 5	5 6	4 7	13 6	10 3
Low-skilled	12,231	15 0	10 5	36 7	1 2	5 8	8 2	5 9	5 4	14 0	12 3
Others	56,980	69 9	19 0	28 9	1 9	7 5	5 7	7 1	5 0	13 3	11 7
*7. Origin**											
Most Urbanized Areas	15,495	18 1	28 2	40 0	1 7	2 2	4 8	1 2	4 6	10 1	7 1
Other Major Cities	5,128	6 0	24 9	30 0	1 5	5 0	3 7	6 5	4 5	9 8	14 1
Rural Prefectures	64,906	75 9	16 2	26 9	2 1	8 6	6 4	8 1	5 0	14 2	12 4

* See Table 5 2

and is increased sharply to 16.5 when World City is deleted out of the model.

The best destination choice model also reveals some strong effects of economic restructuring and globalization. The positive coefficients of World City (0.285) and its interactions with College (0.563) and University (0.832) indicate (1) that Taipei City (where many company headquarters were located) was very attractive to all types of young primary migrants and (2) that this attractiveness increased markedly through the college and university levels of education. The positive coefficients of World City Suburban and its interaction terms indicate that the suburban of the Taipei metropolitan area also had similar but somewhat weaker effects.[13] The positive coefficients of Science Park (0.144) and its interactions with College (0.583) and University (1.524) show that the rapid expansion of high-tech industries in Hsinchu City had increased the attractiveness of the city, which was very strong to the primary migrants with college education and extremely strong to those with university education.

The effects of relative location and size of ecumene imposed a very strong constraint on the destination choice behaviors of the young adult primary migrants: distance and destination population size turned out to be of the most powerful explanatory variables. The negative coefficient of the logarithm of distance and the positive coefficient of the logarithm of destination population size suggest that the job opportunities perceived by these primary migrants tended to decrease with distance and to increase with destination population. The significant interaction between distance and educational attainment in the model indicates that the distance decay effect was weaker for those with college or university education,

---

[13] It is useful to note that in the large metropolitan areas of Taiwan and Japan, many well-off people prefer to live in the central cities. The phenomenon of the upper income class preferring to residing in suburban areas in Western countries is less prevalent in these Asian countries.

suggesting that the better educated had a broader information field and a broader job market. The positive coefficient of Contiguity had the expected effect of the lack of "intervening opportunities" between origin and destination (Stouffer 1940). Also note that the positive coefficient of Contiguity*Married suggests that the migration of those who got married tended to be short distance-residential relocation.

The indicators of housing conditions and quality of life also played sensible roles in accounting for the destination choice behaviors of the young primary migrants: housing cost had a general negative effect, housing growth had a positive effect on those who got married, and population density had a general negative effect.

In the end, it is useful to highlight some prominent spatial patterns of destination choices made by the young primary migrants (Table 5.4). First, the core and suburban area of the World City (Taipei City and Taipei Hsien) attracted a huge share of the primary young labor migrants (nearly 50%), with the attraction of the core increasing sharply with the migrants' educational attainment. Second, with respect to the low-skilled migrants, Taipei City's attraction was particularly weak, whereas Taipei Hsien's attraction was particularly strong. To a lesser extent, similar type of contrast between a central city and its suburban area can also be seen in other metropolitan areas and help account for the lack of domination of suburban populations by the upper class in Taiwan. Third, the second largest metropolitan area (Kaohsiung City and Kaohsiung Hsien), being dominated by traditional heavy and petrochemical industries, was less capable of attracting primary migrants than the third largest metropolitan area (Taichung City and Taichung Hsien) which experienced a

speculative boom in the real estate market.[14] Fourth, the shares of the primary migrants by the Science Park City (Hsinchu) increased sharply from about 1% at the bottom of the educational hierarchy to more than 5% at the top. Fifth, the share of the primary migrants by the rural prefectures decreased monotonically from about 15% at the bottom of the educational hierarchy to less than 10% at the top, contributing to an increasing polarization in the quality of human capital between urban and rural prefectures.

5.6 Concluding Discussion

By applying a two-level nested logit model to a multidimensional tabulation disaggregated from the full records of the1990 Taiwanese census, we have attempted to identify and assess the determinants of the 1985-90 migration behaviors of the young (aged 25-29) natives of the labor force in the context of economic restructuring and globalization.

First of all, the changing regional economic structure as produced by the trend of ***economic restructuring and globalization*** was crucial to account for the primary migration behaviors of the young labor force. As a World City performing the functions of corporate command center, ***Taipei City*** indeed had a very strong power to retain the best educated natives and to attract the best educated primary migrants from the rest of the country. However, it pushed out the less educated and low-skilled natives (mostly to its suburban area) and did not have a particularly strong attraction to the primary migrants with the least education or low skills, suggesting that the low-skilled jobs that might have been generated

---

[14] The large surplus of domestic savings over domestic investment in the late 1980's in Taiwan contributed to the creation of the so-called bubble economy, which involved a massive expansion of speculative activities in the stock and real estate markets. The real estate boom of Taichung was part of this feverish phenomenon. Among all prefectures, Taichung City had the highest housing growth in 1985-90 (Appendix Table 5.1).

to serve the needs of the increasing numbers of managers and professionals did not attract low-skilled primary migrants into the core city. Although its suburban area (Taipei Hsien) attracted disproportionately large numbers of low-skilled laborers, the metropolitan area of Taipei as a whole was actually somewhat more attractive to the middle class than the lower class.

The clearest evidence of the effects of economic restructuring on primary migration was seen in ***Hsinchu City*** (Taiwan's Silicon Valley), which not only had very strong ability to retain the best-educated natives, but also was very capable of drawing the best-educated primary migrants. A less apparent evidence was the particularly weak ability of the second largest metropolitan area (Kaohsiung) to attract the best-educated primary migrants, because of the strong domination of its economy by the traditional heavy and petrochemical industries.

We have also found some evidences indicating the avoidance of unpleasant manual work and the continuation of the urbanization process. Although primary migration in Taiwan was mainly rural-to-urban in nature, the natives who remained in ***the agricultural sector*** were particularly sedentary so that most of the primary migrants into urbanized prefectures were rural non-agricultural workers. Furthermore, most of the young natives had a strong tendency to remain in the prefectures with a high proportion of employment in the non-agricultural sector. The prefectures with a high per capita government spending, which presumably created more service jobs in the public sector, also had a strong capacity to retain native service workers and to attract the primary migrants who were service workers.[15]

---

[15] The increase in the tendency to avoid unpleasant manul work also resulted in a chronic shortage of manual workers in Taiwan since the late 1980's, leading to the massive

Although the less educated natives were less likely to make interprefectural migrations than those with better education, it is important to note that the ***low-skilled*** natives were very responsive to the interprefectural variation in employment growth. This responsiveness may help explain why unemployment rates were similarly low in all prefectures of Taiwan (Appendix Table 5.1). It is probably related to the fact that Taiwan has not yet started a national unemployment insurance program.

In addition to the market forces, some cultural factors were also crucial to explain the behaviors of primary migration in Taiwan. The strong ***patriarchal ideology*** of the society had led to distinctly different migration behaviors between females and breadwinners. Reflecting the norm that females were secondary in economic status relative to males in the society and the persistent sex discrimination in the labor market, the migrations of the women were rather insensitive to the spatial variations in economic opportunities and were strongly affected by changes in marital status, whereas the migrations of the breadwinners were highly responsive to the pushes and pulls of labor market forces.

In sum, the trend of economic restructuring and globalization in the 1980s had influential impacts on the migration behaviors of the young adult natives. Besides, migration of the young adult natives also responded selectively to the effects of Taiwan's patriarchal ideology and the labor market forces. Although primary migration contributed to the polarization of human resources, in both quantity and quality, between the advantaged northern Taiwan and the rest of the country, the strong responsiveness of low-skilled laborers

---

inflow of foreign laborers from low-wage countries like Thailand and the Philippines in the 1990's. Before Taiwan officially began importing foreign laborers in 1989, there were about 50,000 to 100,000 foreigners working illegally in Taiwan. More than 300,000 permits for labor importation were issued between 1990 and 1994. For more details, see Tsay (1995).

to the spatial variation in employment opportunities suggests that labor migration might also have contributed to the maintenance of low unemployment levels in all prefectures and to the highly efficient utilization of human resources.[16]

[16] This is in sharp contrast to Canada where interregional migrations were unable to reduce the high national unemployment level and the persistent and large interregional variation in unemployment rates (Liaw 1998). In our opinion, one possible reason for this difference might be that Taiwan has not yet started a national unemployment insurance program.

Appendix 5.1. Definition of the Explanatory Variables in the Nested Logit Model

Breadwinner Status This variable assumes the value of 1 otherwise 0, if an individual reported that she/he was obliged to assume the responsibility of her/his family livelihood at the time of census.

Dummy Variable of the Agriculture Sector This variable assumes the value of 1 otherwise 0, if the type of economic activities an individual was engaging in at the time of census belonged to the "Primary Category of Agriculture, Forestry, and Fishing and Animal Husbandry" of the 1991 Standard Classification of Industry published by the Directorate-general of Budget, Accounting, and Statistics, Taiwan (DGBAS 1991).

Dummy Variable of the Industrial Sector This variable assumes the value of 1 otherwise 0, if the type of economic activities an individual was engaging in at the time of census belonged to the following "Primary Categories" of the 1991 Standard Classification of Industry: (1) Mining and Quarrying, (2) Manufacturing, (3) Electricity, Gas and Water, (4) Construction (DGBAS 1991).

Dummy Variable of the Service Sector This variable assumes the value of 1 otherwise 0, if the type of economic activities an individual was engaging in at the time of census belonged to neither Agricultural Sector nor Industrial Sector mentioned above.

Dummy Variable of Low-skilled Laborers This variable assumes the value of 1 otherwise 0, if the occupational position of an individual in a specific entity of entrepreneur at the time of census belonged to either (1) the "Primary Category of Elementary Occupations" or (2) some other more detailed subcategories showing less-skilled requirement (identified by the author) of the 1992 Standard Classification of Occupation (DGBAS 1992).

Population Size This variable is the average size of population at prefectural level during the period of 1985-90, derived from the 1985-90 Yearbooks of Manpower Survey in Taiwan (DGBAS 1986-91a). The unit is 1,000,000 persons.

Population Density This variable is the average population density at prefectural level during the period of 1985-90, derived from the 1993 Taiwan-Fukien Demographic Fact Book (Ministry of Interior 1994). The unit is 1,000 persons/km squared.

Non-agricultural Share of Total Employment This variable is the average of the ratios of the non-agricultural labor force to the total labor force at prefectural level during the period of 1985-90, derived from the 1985-90 Yearbooks of Manpower Survey (DGBAS 1986-91a). The unit is percentage.

Household Income This variable is the average household income at prefectural level during the period of 1985-90, derived from the 1985-90 Reports on Individual Income Survey (DGBAS 1986-91b). The unit is 10,000 NT dollars.

Employment Growth Rate This variable is the average of the annual rates of the civilian employment growth (the civilian employment growth divided by the year-end total employment) at prefectural level during the period of 1985-90, derived from the 1985-90 Yearbooks of Manpower Survey (DGBAS 1986-91a). The unit is percentage per year.

Unemployment Rate This variable is the average of the annual unemployment rates at prefectural level during the period of 1985-90, derived from the 1985-90 Yearbooks of Manpower Survey (DGBAS 1986-91a). The unit is percentage.

Local Finance This variable is the average amount of the local government's expenditure per capita at prefectural level during the period of 1985-90, derived from the 1985-90 Urban and Regional Development Statistics (CEPD 1985-90). The unit is 10,000 NT dollars.

Housing Growth Rate This variable is the average annual growth rate of the floor area of

new building construction at prefectural level divided by average prefectural population size during the period of 1985-90, derived from the 1985-90 Urban and Regional Development Statistics (CEPD 1985-90). The unit is square meter/1,000 persons.

Housing Cost This variable is the average housing expenditure share of total family expenditure at prefecture level during the period of 1985-90, derived from the 1985-90 Urban and Regional Development Statistics (CEPD 1985-90). The unit is percentage.

Inclusive Variable Used exclusively in the departure model, this variable represents the attractiveness of the rest of Taiwan for a specific origin. Its values are computed from the best model of destination choice in equation (3).

Distance Used exclusively in the destination choice model, this variable represents the Euclidian distance between both population centers of the origin and the potential destination. The unit is 100 km.

Contiguity Used exclusively in the destination choice model, this variable is a dummy variable assuming the value of 1 otherwise 0, if the origin and the potential destination share the common borders.

Appendix Table 5.1. The Ecological Variables used for the Analyses of Primary Migration of the Labor Force in Taiwan, 1985-90.

Hsien/City by Region	Population Size (1000 Persons)	Population Density (Person/KM²)	Non-agri. Share of Labor Force(%)	Employment Growth (%)	Unemp. Rate (%)	Household Income NT $	Hous. Cost As % of Hous. Income(%)	Gove. Expe. Per Capita NT $	Housing Growth (m2/1000Psn)
Northern Region									
Taipei City	2,620	9,702	98.8	3.56	2.50	629,999	21.5	23,685	1.5122
Keelung City	350	2,638	96.6	0.75	4.57	483,376	12.8	11,051	0.9314
Hsinchu City	311	2,840	94.5	2.41	2.49	554,385	13.5	8,653	1.2958
Taipei Hsien	2,813	1,388	95.8	4.19	2.05	501,695	17.7	6,693	1.5798
Taoyuan Hsien	1,264	1,047	89.7	2.87	1.68	472,467	12.9	6,176	1.9731
Hsinchu Hsien	368	259	83.5	2.73	1.63	467,544	12.8	9,812	1.4511
Ilan Hsien	448	210	82.7	1.51	2.62	422,639	12.1	8,691	1.0491
Central Region									
Taichung City	714	4,425	94.1	2.38	2.69	560,916	18.0	12,887	2.7675
Taichung Hsien	1,186	584	81.4	2.85	1.34	450,344	14.7	6,081	1.5852
Changhwa Hsien	1,229	1,147	73.8	1.58	1.47	415,374	14.2	5,914	1.2823
Yunlin Hsien	774	598	57.7	0.42	1.35	338,215	11.7	7,890	0.8721
Miaoli Hsien	547	301	82.3	-0.72	1.62	459,797	12.7	7,520	1.0951
Nantou Hsien	534	130	68.0	-0.49	2.23	403,230	12.8	8,871	0.9663
Southern Region									
Kaohsiung City	1,341	8,784	95.3	2.84	2.70	512,156	15.8	16,204	1.7040
Tainan City	658	3,767	92.8	4.09	3.06	466,928	17.4	8,099	1.7052
Chiayi City	255	4,254	89.8	1.88	3.62	446,190	12.9	8,905	1.5569
Kaohsiung Hsien	1,088	392	77.5	2.33	2.25	408,052	12.6	7,056	1.3989
Tainan Hsien	1,007	501	72.0	0.86	1.72	377,148	12.3	7,042	1.5204
Chiayi Hsien	559	294	59.4	0.25	1.38	343,658	10.1	9,267	0.5886
Pingtung Hsien	895	322	66.4	1.18	1.84	393,787	12.1	7,623	0.9486
Penghu Hsien	99	778	66.7	-1.34	2.69	377,638	10.5	17,204	0.7374
Eastern Region									
Hualien Hsien	356	77	76.0	1.17	2.58	387,163	11.2	10,551	1.1657
Taitung Hsien	266	76	62.7	-0.20	2.12	339,951	12.2	12,992	0.6917

Note: all figures are average values of 1985-90.

Chapter 6

Return and Onward Migrations of the Young Labor Force in Taiwan: Evidence from the Data of the1990 Census

6.1 Introduction

The central theme of this chapter will emphasize two views on the causes of repeat migrations of the labor force that have different policy implications. Reasons for stressing these two views are mainly based on the existing theories of (Morrison 1971; Yezer and Thurston 1976; Da Vanzo 1981; Herzog and Schlottmann 1982; Grant and Vanderkamp 1986) and the empirical findings on (e.g. Miller 1977; Long 1988; Newbold and Liaw 1994) repeat migration.

The first view is based on the ***disappointment hypothesis***. In this view, repeat migration is considered as an action of correcting previous migration mistake. A high level of repeat migration is taken as evidence of the ***inefficiency*** of migration process, which can be rectified by a policy that improves the quality of information about the economic opportunities in different markets. Thus, the success of such a policy will result in a reduction of unnecessary repeat migrations, especially those that occur soon after previous moves.

The second view is to stress that repeat migrations are an outcome of the response

of previous migrants to the adjustment process of market over time. In this view, a high level of repeat migration is thus considered as the responsiveness of the labor force to the changing spatial pattern of the demand for labor that previous migrants continue to move to places where new economic activities are emerging or better opportunities become available. Therefore, repeat migrations serve a role of promoting the ***efficiency*** of market adjustment and there is no need to propose a policy aiming at intervening the phenomena of pervasive repeat migrations. This view will be termed as the ***responsiveness hypothesis*** in this chapter.

By decomposing repeat migration into return migration and onward migration, previous research suggests that information-related and economic factors are less important in explaining return migration, because of the intervening effects of location-specific capital left behind and the familiarity of previous migrants with their "home" region. In spite of this, return migrants still respond to the economic conditions of home region in a rational way. By contrast, onward migrants are found to be more aware of and sensitive to the spatial economic opportunities than return migrants, suggesting that onward migrants relatively are more sensitive to the spatial economic variations. In addition, onward migrants tend to behave more like migration risk-takers as opposed to the risk-avoiding tendency of returnees (Da Vanzo 1981 and 1983, Newbold and Liaw 1994; Newbold 1996).

However, as noted by Morrison and Da Vanzo (1986), the characteristics of repeat migrants, either return or onward, tend to vary with the tempo of making a subsequent move. They indicate that those who rapidly return tend to differ distinctly from those who rapidly move onward and those returnees with longer absences. Fast return migration tends to select those with less human capital and those whose previous moves turned out to be disappointing or unsuccessful in the labor market, whereas non-fast return migration is less

selective or even nonselective. By contrast, onward migration, either fast or non-fast, is selective of the more educated, mostly with professional and managerial occupation. Therefore, the determinants of repeat migration may vary with different sources of migration data. Since the repeat migration of a disappointed previous migrant tends to occur quickly following the initial move, the data of sampling surveys that yield re-migration information within a shorter time interval like one year period (see Chapter 7) tend to support the disappointment hypothesis. By contrast, the longitudinal data set is more suitable for the study of the responsiveness of previous migrants to the market forces, because of its temporal depth.

Compared with the annual surveys and longitudinal data, the census data tend to have less temporal specificity to allow critical tests of both viewpoints. Moreover, because of lacking the information on the timing of migration, the 5-year-period census data will include both cases of fast and non-fast repeat migrations. Therefore, it is expected that the effects of information-related factors, such as previous migration distance and education, on return migration revealed by the census won't be very distinctive. Despite this shortcoming, the census data have a very broad spatial coverage and the advantage of containing the whole population, enabling us to conduct a comprehensive analysis on repeat migration.

This chapter is to identify and assess the determinants of 1985-90 interprefectural return and onward migrations of the young (aged 25-29 in 1990) labor force in Taiwan, by applying a three-level nested logit model to the rich data of the 1990 census. Since disappointments are more likely to result in return migrations, and onward migrations are more prone to be induced by the pursuits of newly emerged or better opportunities, the separation of repeat migrations into return and onward types is expected to throw clearer

lights on the determinants related to the disappointment and responsiveness hypotheses, respectively.

This chapter is structured as follows. Section 6.2 describes the data and a three-level nested logit model, consisting of the departure, return/onward, and onward destination choice models. Section 6.3 discusses the selection of explanatory variables. Section 6.4, 6.5, and 6.6 reports the empirical findings from the three models, respectively. Section 6.7 is the conclusion.

6.2 Data and Statistical Model

The data set is a multidimensional tabulation disaggregated from the full records of the 1990 Taiwanese census. The geographic units for defining migration are the 23 prefectures of Taiwan, including 7 major cities and 16 "hsien". As a proxy for the prefecture of birth, "native domicile" is used to define the nativity status (native-born versus non-native) of a person. In this chapter, those residing in their prefecture of native domicile in 1985 are defined as natives, otherwise non-natives. The population in question (or potential migrants, ***PM***'s) are the Taiwanese ***non-native*** young labor force aged 25-90 in 1990.[1] A non-native is classified as a ***repeat migrant*** if her/his 1985 and 1990 prefectures of residence are different, otherwise as a stayer.[2] A repeat migrant is classified as a ***return migrant*** if she/he

---

[1] The so-called "Chinese Mainlanders" and foreigners are excluded out of this research. Reasons for excluding them are discussed in Chapter 5.

[2] A shortcoming of the census data is that using the 1985 and 1990 prefectures of residence to distinguish migrants from stayers always results in an undercount of migrations, especially fast repeat migrations. Because of this shortcoming, the study based on the census data tends to understate the importance of disappointment hypothesis.

migrated back to her/his prefecture of native domicile in 1985-90, otherwise as a ***onward migrant***.

To formulate the statistical model of explaining the behaviors and identifying the determinants of repeat labor migration in 1985-90, we stratify the choice set of a non-native into a three-level hierarchy (Herzog and Schlottmann 1982). ***At the top level***, the non-native faces the choice of being a repeat migrant or a stayer. If the non-native decides to migrate, the choice at ***the middle level*** is either to return or to move onward. In case the non-native decides to make an onward migration, the choice at ***the bottom level*** is to select a specific destination in the set of the remaining prefectures. Based on a discrete choice theory (Ben-Akiva and Lerman 1985; Kanaroglou et al 1986), the probabilities of making the choices at the three levels can be linked to the observable attributes of both the choice-makers and the alternatives in the choice set via a three-level nested logit model, consisting of a departure model at the top level, a return/onward model at the middle, and a onward destination choice model at the bottom (Newbold and Liaw 1994).

Departure model: the top level

The probability of a non-native i departing from her/his prefecture of residence o, $P_i(o)$, is formulated as:

$$(1.a) \qquad P_i(o) = \frac{exp(V_{oi})}{1 + exp(V_{oi})}, \quad V_{oi} = B_a + B_b X_{oi} + B_c I_{oi};$$

where V_{oi} represents the difference in utility between the rest of the country and prefecture o perceived by the non-native i; B_a is the coefficient of constant term, B_b is a row vector of unknown coefficients associated with the column vector X_{oi}, the elements of which consist

of the personal characteristics of i and the place attributes of o as well as their interactions; B_c is the coefficient of the so-called inclusive variable I_{oi}, which is defined as

$$(1.b) \qquad I_{o\,i} = Ln\left(\sum_{i \in \text{the PM's}} [\, 1 + \exp(V_{R\,i}) \,] \right);$$

note that $I_{o\,i}$ represents the attractiveness of the rest of the country perceived by the non-native i and that its coefficient B_c is theoretically bounded between 0 and 1. The values of $I_{o\,i}$ in *(1.b)* is aggregated from the return/onward model in *(2.a)*. The meaning of $V_{R\,i}$ is defined in the return/onward model.

Return/onward model: the middle level

Under the condition that the non-native i decides to migrate, the probability of the non-native i returning to her/his prefecture of native domicile R, $P_i(R)$, is also formulated by a binary logit probability:

$$(2.a) \qquad P_i(R) = \frac{\exp(V_{R\,i})}{1 + \exp(V_{R\,i})}, \quad V_{R\,i} = C_a + C_b X_{R\,i} + C_c I_{R\,i};$$

where V_{Ri} is the difference in the utility of returning to native domicile R and making onward migration, perceived by the non-native migrant i; C_a is the coefficient of constant term, C_b is a row coefficient vector associated with column vector X_{Ri}, which elements consist of the personal characteristics (e.g. sex and education) of i and the ecological variables (the socioeconomic attributes like income level and employment growth) of native domicile R; C_c is the coefficient of the inclusive variable I_{Ri} and is theoretically bounded between -1 and 0; the inclusive variable $I_{R\,i}$, which values are aggregated from *(3)*, is formulated as below:

$$(2.b) \qquad I_{R\,i} = Ln\,(\sum_{d \in D} exp(\,V_{d\,i}\,)\,)\;;$$

note that $I_{R\,i}$ represents the aggregate attractiveness of the prefectures excluding R and O perceived by migrant i, and that 1 - $P_i(R)$ simply represents the conditional probability of choosing onward option. Note that $V_{d\,i}$ is defined in the onward destination choice model.

Onward destination choice model: the bottom level

Under the condition that the non-native i decides to depart and to make onward migration, the probability of choosing a specific destination d from the choice set D (the set of all possible destinations excluding R and O), $P_i(d)$, is formulated by a multinominal logit probability, reading as

$$(3) \qquad P_i(\,d\,) = \frac{exp(\,V_{d\,i}\,)}{\sum_{d' \in D} exp(\,V_{d'\,i}\,)} \;,\quad V_{d\,i} = B_d\,X_{di}\;,\; d \in D\;;$$

where $V_{d\,i}$ represents the utility of destination d perceived by the non-native i; B_d is a row coefficient vector associated with column vector $X_{d\,i}$ which elements consist of the observable explanatory variables (including the ecological variables of d and the interaction terms of personal characteristics of i with the ecological variables of d).

Estimation method and the assessment of explanatory power

The input data sets for the three models are multidimensional tabulations of the young adult non-natives in the labor force. The unknown coefficients are estimated by the maximum quasi-likelihood method through the Newton-Raphson algorithm (McCullagh 1983; Liaw and Ledent 1987). The estimation method is applied sequentially from the

bottom to the top level. Since the number of observations for each model is very large[3], the estimates of unknown coefficients can be empirically considered as being normally distributed, and the t-ratio of an estimated coefficient (i.e. the estimated coefficient divided by the corresponding asymptotic standard error) with a magnitude of more than 1.96 can be viewed as statistically significant.

The goodness of fit of a specification of the model is measured by the Rho-square defined as $\rho^2 = 1 - L / L_o$, where L is the logarithm of maximum quasi-likelihood of the specification in question, and L_o is the logarithm of maximum quasi-likelihood of the null model (i.e. the model including only the constant term). Although this statistic is theoretically bounded between 0 and 1, the ceiling of it is empirically much less than one so that a value of 0.2 can represent an ideal fit (McFadden, 1974).

This research presents the estimation result of the "best model", namely, the model in which all the explanatory variables are of statistically significant and substantively meaningful. To assess the relative explanatory power of the subsets of explanatory variables in the best model, we delete each subset in turn from the best model and compare the resulting decreases in Rho-square defined as $\rho^2 - \rho^2(R)$, where ρ^2 and $\rho^2(R)$ are the corresponding Rho-square of the best model and the reduced model, respectively. The assessment principle is: the greater the decrease in the Rho-square, the more important the

---

[3] In the departure branch, there are 122,191 observations representing 320,898 non-natives aged 25-29 in the labor force. In the return/onward branch, there are 48,911 observations representing 65,850 non-native young migrants. The estimation results of onward destination choice are based on 668,157 bundles of 21 observations (corresponding to 21 potential destinations) representing 39,339 onward migrants.

deleted subset of explanatory variables.[4]

6.3 Selection of the Explanatory Factors

Since the personal factors and prefectural attributes affecting primary migration (migration of the natives) can also affect return and onward migrations, the explanatory factors used to explain primary migration in Chapter 5 are also used in this study. In addition, the ***distance to native domicile*** is incorporated as an additional explanatory factor in the departure and return/onward models. This factor is used as a proxy for the previous migration distance of the non-natives, although a non-native might have migrated more than once so that the last move might not be from the prefecture of native domicile. The effects of this factor may be ***non-monotonic***, because it is related not only to the reliability of information used in previous migration, but also to the costs of previous migration and the speed at which the location-specific capital in native domicile depreciates. Due to ***the budget constraint*** (see Chapter 7), it may also affect the ability to finance a repeat migration. Its expected effects are presented below.

Since the quality of information used in the previous migration tends to deteriorate with longer migration distance, a previous migrant who came from a more distant prefecture is more likely to be disappointed and hence to re-migrate. According to the disappointment hypothesis, the distance to native domicile can be expected to have a ***positive effect*** on the probability of making repeat migration.

Through its effect on the ability to preserve the value of location-specific capital in

---

[4] Note that this assessment method does not take into account the dimension of degree of freedom. For details, see Chapter 5.

the native domicile, the distance to native domicile can also be expected to have a strong ***negative effect*** on the propensity of making return migration.[5] Like other forms of capital, the location-specific capital left in the native domicile tends to depreciate with the duration of absence. One way to avoid or slow down this depreciation for a previous out-migrant is to maintain ongoing contacts with relatives/friends in the native domicile, including frequent mutual visits. In Taiwan, such direct contacts tend to decrease sharply with an increase in distance and may become rather infrequent beyond 50 or 100 kilometers.[6] Thus, to the extent that the attraction of location-specific capital left behind is crucial for return migration, return propensity is expected to decrease sharply with the distance to native domicile up to about 50 or 100 kilometers.[7] Beyond these distances, the magnetic effect of location-specific capital may be neutralized and eventually overwhelmed by the disappointment (or information) effect so that the propensity to return may remain low for some distances and then increase with the distance to native domicile.

---

[5] This negative effect may be somewhat strengthened by the fact that for a return migrant, the distance to native domicile represents not only the previous migration distance but also the current migration distance, which has a positive effect on the out-of-pocket moving cost of current migration and is hence expected to have a negative effect on the propensity to make a return migration, ceteris paribus. The out-of-pocket moving cost, especially over short distances, tends to be rather small according to the cost-benefit calculation (Sjaastad 1961).

[6] The main reason is not due to the constraint of transportation system. Rather, it is mainly due to the fact that the average range of daily life in Taiwan is relatively much shorter than that in North America. For example, as revealed by the 1990 Taiwanese census, the commuting distance of the labor force is barely over 50 kilometers.

[7] For fast repeat migrations, the effect of the depreciations of location-specific capital left in previous residence tends to be relatively unimportant for different levels of previous moving distance, because of the shortness of the duration of absence (i.e. the shortness of the depreciation period). For details, see Chapter 7.

On the other hand, since location-specific capital in the native domicile does not have a direct effect on the propensity to make onward migration, the effect of the distance to native domicile on onward migration is expected to reflect only the disappointment effect. Namely, the longer the distance of previous migration, the greater the propensity of making onward migration.[8] Therefore, the strong attractiveness of location-specific capital in the native domicile over short distances implies that the return/onward ratio tends (1) to be rather high at a short distance and then (2) to decrease sharply with an increase with previous migration distance. By ***countering*** the disappointment effect, it also implies that the departure propensity (the sum of return migration propensity and onward migration propensity) may be a rather weak positive function of the distance, unless the distance is quite large (say, beyond 200 kilometers).

Also note that if previous migration distance is quite long, the behaviors of repeat migration may be affected by the budget constraint: the longer the previous migration distance, the less the resources left for a migration after the initial move. Since a return migrant can benefit from the help of relatives/friends in the native domicile, the main effect of budget constraint is mainly limited to onward migration. However, the effect of budget constraint may not be important for ***non-fast onward migrants***, because they might have gained sufficient benefits from previous migration which facilitate to overcome such a constraint. As a result, the return/onward ratio is expected to increase with an increase in the distance to native domicile at relatively long distances.

---

[8] When dealing exclusively with fast repeat migrations, the positive relationship between onward migration propensity and previous moving distance may be reversed at relatively long distances due to the effect of budget constraint. For details, see Chapter 7.

6.4 Findings from the Departure Model

Estimation of the departure model is based on the 122,191 records representing 320,898 non-native young adults in the labor force. The estimation results of the best departure model is summarized in Table 6.1, while the aggregate observed and predicted departure rates by a set of explanatory variables are shown in Table 6.2. By comparing the observed and predicted figures in Table 6.2, the best departure model does fit the data very well, although the corresponding Rho-square is only 0.0660. The observed overall departure rate of the young non-natives was as high as 21%, which was slightly more than two times the rate of their native counterparts (see Chapter 5), suggesting the non-natives indeed were rather footloose.

The most important factors in the departure model are ***marital status and sex***. The estimated coefficients of the dummy variables for marital status and their interactions with sex suggest that the migration behaviors of the young non-natives were affected not only by the incidence of ***change in marital status***[9] but also by the norm of Taiwan's ***patriarchal society***. The positive coefficients of Married (0.239), Divorced/Separated (0.238), and Widowed (0.477) indicate that the married, divorced/separated and widowed young adults were more prone to re-migrate than those who remained single. Since the young adults in the 25-29 age group in 1990 were in the 20-24 age group in 1985, those who were in any one of the non-single marital statuses in 1990 were most likely to have experienced a change in marital status during 1985-90. Therefore, these positive coefficients suggest that change in

[9] It is very important to note that because the young non-natives aged 25-29 were in the prime age of marriage during 1985-90, those whose marital status being recorded as non-single (i.e. married, divorced/separated, and widowed) at the time of census mostly likely had experienced the incidence of marital status change in 1985-90.

marital status tended to increase the propensity of re-migration. The effects of the patriarchal society are revealed by the large positive coefficients of the interaction terms, Married*Female (0.706) and Divorced/ Separated*Female (0.965), which indicate that the enhancing effect of either getting married or becoming divorced/separated on re-migration propensity tended to be much stronger for females than for males. The observed departure rates were quite consistent with the multivariate results (Table 6.2): 29% for the married females versus 21% for the married males; 36% for the divorced/separated females versus 20% for the divorced/separated males.

In addition to enhancing the positive effect of change in marital status on the re-migration propensities of females, the norm of patriarchal society in Taiwan also affected ***the relative sensitivity*** of breadwinners (mostly males) and non-breadwinners to the market forces. The positive coefficient of Breadwinner (0.520) reveals that breadwinners were more migratory than non-breadwinners in general. Furthermore, the negative coefficients of Employment Growth (-0.034) and Employment Growth*Breadwinner (-0.085) indicate that the retention effect of employment growth was much stronger on breadwinners than on non-breadwinners, whereas the positive coefficient of Rural Unemployment Rate*Breadwinner (0.111) shows that the push effect of high unemployment rate was statistically significant on only the breadwinners of rural prefectures. Therefore, these findings can be considered as a consequence of the fact that under the patriarchal system of Taiwan, breadwinners are expected to assume much more ***responsibility for familial economic well-beings*** than are non-breadwinners.

Table 6.1. Estimation Results of the Departure Model for the Non-native Labor Force Aged 25-29 : Based on the 1990 Population Census, Taiwan.

Explanatory Variable	The Best Model		Change in
	Coefficient	t-ratio	Rho-square
Constant Term	-2 156	-11 6	
I. Personal Attributes			
1. Effects of Marital Status and Sex(Refe.: All Others)			0 0196
Married	0.239	11 6	
Married*Female	0.706	28.2	
Divorced/Separated	0.238	2 4	
Divorced/Separated*Female	0.965	8.0	
Widowed	0 477	3.0	
2. Effects of Education(Refe.: Primary Education)			0 0102
Junior High	0.125	3.9	
Senior High	0.136	4.4	
College	0.486	13.5	
University	1.033	27.3	
3. Effect of Breadwinner Status(Refe.: Non-breadwinner)			0 0013
Breadwinner	0 520	12 6	
4. Effect of Industry (Refe.: Non-agricultural Worker)			0 0011
Agricultural Worker	0.740	11.8	
5. Effect of Previous Migraition Distance			0 0044
Ln(Distance to Native Domicile)	0 231	23.4	
II. Ecological Variables and Interaction Terms			
1. Effect of Size of Ecumene			0 0027
Ln(Population Size)	-0 333	-18.6	
2. Effects of Quality of Life			0 0004
Population Density	0.023	5 6	
Ln(Housing Cost)	0.330	3.4	
3. Effects of Labor Market Variables			0 0121
Effects of Employment Structure			
Ln(Non-agri. Share of Total Employment)	-2.623	-23 1	
Ln(Non-agri. Share of Total Employment)*Agricultural Worker	4 687	19.4	
Effects of Employment Growth			
Employment Growth	-0 034	-5.2	
Employment Growth*Breadwinner	-0.085	-7.8	
Employment Growth*Female*Low-skilled Labor	-0.017	-2.0	
Effect of Unemployment			
Rural Unemployment Rate*Breadwinner	0 111	5.9	
Effect of Local Finance			
Local Government Expenditure Per Capita*Service Sector Worker	-0 429	-15.5	
4. Effects of World City			0 0035
World City	0.636	15.9	
World City*College	-0 425	-9 3	
World City*University	-0.790	-17.1	
5. Effect of World City Suburban			0 0003
Science Park	-0.397	-5 7	
6. Effect of the Attractiveness of the Rest of the System			0.0022
Inclusive Variable	0.578	16.7	
Rho-square	0 0660		

The best departure model provides substantial supports on ***the responsiveness hypothesis***. First, consistent with the findings from North American censuses (Long 1988; Newbold and Liaw 1994), the increasingly positive coefficients of the dummy variables representing higher levels of education (0.125 for Junior High, 0.136 for Senior High, 0.486 for College, and as high as 1.033 for University) indicate that the re-migration propensities increased with educational attainment and were particularly high at the university level. Since the better educated tended to have better information and were less likely to be disappointed by the outcome of the previous migration, their stronger propensities to re-migrate could not be due to greater disappointment. Rather, the higher propensities should be attributed to their greater willingness to move to places with better or newly emerged opportunities. Second, the estimated coefficients of labor market variables indicate (1) that the non-natives in general were more likely to out-migrate from the prefectures with low employment growth, (2) that the non-natives in the service sector had a rather strong tendency to remain in a prefecture where many service jobs had presumably been created by a large local government expenditure per capita. Third, the increasing importance of Taipei City as a World City in the late 1980s, offering many high-skilled jobs, was reflected by its strong capacity to retain its college- and university-educated non-natives. Fourth, the expansion of the large-scale Science Park in Hsinchu City (Taiwan's Silicon Valley) in the 1980s was also reflected by its strong power to retain its non-natives.

The best departure model also provides some supports for ***the disappointment hypothesis***, partly due to the inclusion of fast repeat migrants in the census. First, the positive coefficient (0.231) of the variable Ln(Distance to Native Domicile) suggests that the propensity to make repeat migration indeed increased with the distance of previous

migration, supporting the reasoning that the longer the previous migration distance, the less reliable the information used, the more likely the disappointment with the outcome of previous migration, and thus the greater the re-migration propensity. Consistent with the multivariate finding, both observed and predicted departure rates were an increasing function of previous moving distance (Table 6.2). Second, contrary to the non-agricultural workers who are shown to be less likely to re-migrate from a prefecture with a high proportion of its total employment in the non-agricultural sector, the agricultural workers are shown to be highly prone to depart from such a prefecture. This result suggests that the agricultural workers who previously migrated to a prefecture with few agricultural job opportunities were most likely to be disappointed and hence to re-migrate.

The best departure model also suggests that the farmland in the native domicile might be a very important form of ***location-specific capital*** for agricultural workers. Contrary to the large negative coefficient (-0.9337) in the departure model of their native counterparts (see Chapter 5), the coefficient of Agricultural Worker (0.740) turned out to be highly positive in the departure model of the non-natives. This sharp contrast suggests that farmland in the native domicile had a very strong power to retain the native agricultural workers and to pull back the non-native agricultural workers.

As suggested by the positive coefficients of Population Density (0.0231, t=5.6) and Ln(Housing Cost) (0.3297, t=3.4) in the best model, concerns with the ***quality of life*** and ***cost of living*** were also important to the departure decisions of the young non-natives: the non-natives were subject to the push effects of high population density and high housing cost. Note that housing cost was not a statistically significant factor in the departure model of the young adult natives (see Chapter 5), most likely because many of the young natives

were living in their parental homes and did not have to pay the rent.

Table 6.2. Observed and Predicted Rates of Return and Onward Migrations for the Non-native Labor Force Aged 25-29 by Sex and Marital Status, Education, Breadwinner Status, Industry, Occupation, Origin, and Distance to the Native Domicile : Based on the 1990 Census, Taiwan.

	At-risk Population		Repeat Mig Rate		Return Mig Rate		Onward Mig Rate		Observed
	Volume	Composition	Observed	Predicted	Observed	Predicted	Observed	Predicted	Return/Onward
	(Persons)	(%)	(%)		(%)		(%)		Mig Rate (%)
Total	320,898	100.0	20.5	20.5	8.3	8.2	12 3	12.3	67.4
1. Male									
Single	99,398	52 9	16 6	16.5	6.9	6 7	9.7	9 8	71 0
Married	86,473	46 1	20 9	20.9	7.4	7.5	13 6	13 5	54.4
Div/Sep	1,729	0.9	20 2	20.2	9 3	8 9	11 0	11 3	84.2
Widowed	124	0.1	21.0	27.4	11 3	13 7	9.7	13.7	116.7
2. Female									
Single	56,025	42.1	14.8	15.0	5.8	6.5	9 0	8 5	64 4
Married	73,876	55.5	29 0	29.0	12.6	11.9	16.5	17 1	76 5
Div/Sep	2,814	2.1	36.3	36.3	17.8	17.6	18 5	18.7	96.5
Widowed	459	0 3	27.7	25.9	15.3	13.9	12 4	12.0	122.8
3. Education									
Primary	23,001	7 2	19.8	19.8	9 3	9.2	10 5	10 6	88 6
Junior High	75,780	23.6	19.7	19 7	9.2	9 0	10 5	10 7	87.2
Senior High	126,376	39.4	18.9	18 9	8 0	7 8	10 9	11.1	73.1
College	54,266	16 9	21.1	21.1	7 5	7 6	13 6	13 5	55.2
University	41,475	12.9	26.6	26.6	7 8	8.1	18 7	18 5	41.9
4. Breadwinner Status									
Breadwinner	117,361	36.6	21.3	21 3	6.5	6 3	14 8	15.0	43 7
Non-breadwinner	203,537	63.4	20 1	20.1	9.3	9 3	10 8	10.8	86 1
5. Industry									
Primary	9,531	3.0	26.8	26 8	20 1	19.9	6 6	6 9	303 8
Secondary	134,454	42 8	19.8	19.9	8.3	8.2	11 5	11.7	72.4
Tertiary	170,517	54.2	21.0	20.7	7.7	7.5	13 4	13 2	57 2
6. Occupation									
Professional	41,676	13 8	26 3	24.1	8.4	7 9	17 9	16.2	46 7
Managerial	2,401	0 8	20.4	21.3	5.9	7.2	14 6	14 0	40.3
Low-skilled	40,663	13.4	20.1	19 7	9 6	9.3	10 5	10.4	91.4
Others	218,024	72.0	19 7	20 0	8.2	8 1	11 5	11.9	71.3
*7. Origin**									
Most Urbanized Areas	228,147	71.1	17.0	17.0	6.3	6 3	10.6	10 8	59 4
Other Major Cities	27,996	8.7	19 5	21 3	8.8	9.8	10.7	11 5	82 8
Rural Prefectures	64,755	20 2	33.4	32 4	14.8	14.2	18 6	18.2	79.7
8. Distance to Native Domicile(KM)									
0- 25	54,751	17.1	18.1	18.1	12.8	12 3	5.4	5.7	237 0
25- 50	54,464	17 0	20.8	20.6	9 4	9 8	11.4	10.9	82 1
50- 75	34,793	10 8	19.4	19 7	6.4	7.1	13 0	12.6	48.9
75-100	24,536	7.6	20.9	20.5	6 2	6.2	14 7	14.3	42 5
100-200	95,095	29.6	20 2	20.7	6.3	6.1	13.8	14 6	45 9
200-300	51,700	16 1	22.7	21.5	7 9	6 8	14 8	14.7	53 0
300 +	5,559	1 7	32.5	36 4	10 4	16.4	22.1	20.0	46.8

** The most urbanized areas include Taipei City, Taipei Hsien, and Taoyuan Hsien of northern Taiwan, Taichung City of Central Taiwan, and Kaohsiung City of southern Taiwan. Other major cities are Cities of Keelung, Hsinchu, Chiayi, and Tainan. The remaining prefectures are classified as rural prefectures.*

Finally, the negative coefficient of Ln(Population Size) (-0.3325, t=18.6) indicates that more populous prefectures had a stronger retention power on the young adult non-natives. By contrast, the positive coefficient of Inclusive Variable (0.5783, t=16.7) shows that the aggregate attractiveness of the rest of Taiwan had a very strong power to draw out the young adult natives.

6.5 Findings from the Return/Onward Model

Estimation of the return/onward model is based on the 48,911 records representing 65,850 non-native migrants aged 25-29 in the labor force, of which 26,511 were observed to make return migration. The estimation results of the best return/onward model is summarized in Table 6.3, whereas the observed and predicted indices of return/onward choices are shown in Tables 6.2 and 6.4. The high Rho-square (0.1607) and the closeness between observed and predicted indices in Tables 6.2 and 6.4 show that the best return/onward model fits the data very well.

First of all, the estimation results indicate that the most important determinant was the ***distance of previous migration*** (measured by the distance to the prefecture of native domicile). As suggested by the estimated coefficients of Ln(Distance to Native Domicile) and Distance to Native Domicile (-0.696 and 1.470, respectively), the effect of distance to native domicile on the return/onward ratio was indeed ***U-shaped*** :[10] the declining part suggested that at relatively short distances, the distance's depreciation effect on the location-specific capital in the native domicile outweighed its disappointment effect, whereas the

[10] Let X be a positive-valued explanatory variable, the effect of X represented by the functional form of a*ln(X) + b*X is (1) concave if a < 0 and b > 0; (2) convex if a > 0 and b < 0; (3) monotonic positive if both a and b > 0; and (4) monotonic negative if both a and b < 0. For details, see Chapter 7.

rising part suggested that at relatively long distances, its disappointment effect on onward migration was partially neutralized by the effect of budget constraint. As a matter of fact, the non-linear effect of previous migration distance in the return/onward model is better revealed by the observed patterns of return and onward migration rates with respect to various levels of previous moving distance in Table 6.2: return migration rate was a U-shaped function of previous migration distance[11], whereas onward migration rate increased almost monotonically with previous migration distance.

In light of the very strong concave effect of previous migration distance on the return propensity, the variable of previous migration distance ***won't*** exhibit significant ***linear effect*** in the return/onward model. This may help explain why findings of previous research on the linear effect of previous migration distance for return migration was inconclusive or insignificant. It is also important to note (1) that the sum of both return and onward migration rates, representing repeat migration rate, was an increasing function of previous migration distance, which is consistent with the multivariate finding in the best departure model that previous migration distance had a positive effect on the departure propensity of the young non-natives, and (2) that the strong positive effect of previous migration distance in the departure model was mainly shaped by its strong positive effect on the propensity of making onward migration. In short, the effects of distance to native domicile turned out to be consistent with the expectations derived in Section 6.3 from the disappointment hypothesis and the notions of capital depreciation and budget constraint.

---

[11] The main features of the U-shaped pattern of the return migration rate were (1) a very sharp decrease from 12.8% in the interval of 0-25 kilometers to 9.4% in the 25-50 interval and 6.2% in the 50-75 interval and (2) a sharp increase from 6.3% in the 100-200 interval to 7.9% in the 200-300 interval and 10.4% beyond 300 kms.

Table 6.3. Estimation Results of the Return/Onward Model for the Non-native Labor Force Aged 25-29 : Based on the 1990 Population Census, Taiwan.

Explanatory Variable	The Best Model		Change in
	Coefficient	t-ratio	Rho-square
Constant Term	0.5297	2.5	
I. Personal Attributes			
1. Effects of Marital Status and Sex(Refe.: All Others)			0.0036
Married	0.9471	11.9	
Married*Female	-0.5338	-13.0	
Divorced/Separated	0 2580	3 4	
Widowed	0.6776	3.2	
2. Effects of Education(Refe.: At-most Junior High Schooling)			0.0079
Senior High	-0.2427	-9.0	
College	-0.5614	-16.0	
University	-0 7535	-20.7	
3. Effect of Breadwinner Status(Refe.: Non-breadwinner)			0.0039
Breadwinner	-0.9792	-15.7	
4. Effect of Industry (Refe.: Non-agricultural Worker)			0.0005
Agricultural Worker	0.7906	5 5	
5. Effect of Occupation (Refe.: Non-low-skilled Labor)			0.0007
Low-skilled Labor	0.2349	6.9	
6. Effect of Previous Migration Distance			0 0169
Ln(Distance to Native Domicile)	-0.6960	-29.1	
Distance to Native Domicile	1.4698	19 1	
II. Ecological Variables and Interaction Terms			
1. Effect of Size of Ecumene			0.0010
Ln(Population Size)	0 3525	7 8	
2. Effects of Quality of Life			0.0026
Population Density	-0.1514	-11.1	
Housing Growth	0 2730	5 7	
3. Effects of Labor Market Variables			0.0117
Effects of Employment Structure			
Ln(Non-agri Share of Total Employment)	0 6142	4.1	
Ln(Non-agri. Share of Total Employment)*Service Sector Worker	0.3908	4 8	
Ln(Non-agri. Share of Total Employment)*Agricultural Worker	-3 0743	-8.1	
Effects of Employment Growth			
Employment Growth	0 0772	3 7	
Employment Growth*Female	-0 0349	-2.0	
Employment Growth*Breadwinner	0.1769	10.0	
Effect of Unemployment			
Rural Unemployment Rate*Breadwinner	-0 2395	-8.7	
Effect of Household Income			
Household Income Differential	*0 0107*	8.1	
Effects of Local Finance			
Local Government Expenditure Per Capita	1 0476	9.9	
Local Government Expenditure Per Capita*Service Sector Worker	0.3836	6 3	
4. Effects of World City			0.0007
World City	-0 5828	-4.6	
World City*College	0.6226	4 0	
World City*University	0.8240	5.5	
5. Effect of World City Suburban			0.0002
World City Suburban	0.2589	3 2	
6. Effect of Science Park			0.0010
Science Park	0 8593	8 1	
7. Effect of the Attractiveness of the Rest of the System			0 0019
Inclusive Variable	-0.3575	-11 1	
Rho-square	0 1607		

The second most important factor affecting the choices of the young non-native migrants between return and onward options was ***educational attainment***. As indicated by the estimated coefficients for the dummy variables of educational level (-0.243 for Senior High, -0.561 for the College, and -0.754 for University), education had a negative effect on the return/onward ratio. Consistent with the observed pattern of educational selectivity in Table 6.2, this effect was due to (1) the slightly negative selectivity in return migration (9.3% for those with primary education and 7.8% for those with university education) and (2) the very strong positive selectivity in onward migration (10.5% for those with primary education and 18.7% for those with university education), implying that the better educated, especially the university-educated, were much more likely to take the risk of making onward migration.

In addition to the strong effect of educational attainment, the effects of ***occupational qualification and industrial category*** also helped reveal a general pattern that repeat migrants with poorer and less adaptable human capital were more prone to return than to move onward. The positive coefficient of Low-skilled Labor (0.2349) indicates that the low-skilled laborers who migrated again tended to have a higher return/onward ratio. Similarly, the highly positive coefficient of Agricultural Worker (0.7906) shows that the re-migrated agricultural workers, being largely without useful skills in urban areas and presumably also subject to the strong attraction of location-specific capital (farmland) in the native domicile, were much more prone to return. Note that the observed return/onward ratio was 91.4% for low-skilled laborers and 303.8% for agricultural workers, compared with 67.4% for all young adult repeat migrants in the labor force.

Findings on ***the joint effects of marital status and sex*** were also noteworthy. First, when repeat migration was triggered by marriage, the young non-natives were more prone

to return than to move onward. However, this return tendency was reduced substantially for females, because under Taiwan's patriarchal ideology a bride is expected to move to her groom's place of residence in general. Second, when repeat migration was induced by unsuccessful marriage experience or by the incidence of spousal death, the young non-natives were more prone to return rather than to move onward.

The influence of patriarchal value system was also revealed by ***the sharp contrast between breadwinners and non-breadwinners*** in their return/onward choices. As indicated by the large negative coefficient of Breadwinner (-0.979), breadwinners were less prone to choose return option. In other words, with a greater responsibility to improve familial economic well-being, breadwinners were more prone to take the risk of making onward migration. This multivariate finding is consistent with the observed differences in both return migration rate (6.5% for breadwinners versus 9.3% for non-breadwinners) and onward migration rate (14.8% for breadwinners versus 10.8% for non-breadwinners) in Table 6.2.

Although those repeat migrants with poorer human capital were more prone to return than to move onward, return migrants were still responsive to the differences in ***economic opportunities in the native domiciles***. In other words, the native domiciles with better economic opportunities were more capable of getting back their departed natives. The coefficients of Employment Growth (0.0772), Employment Growth*Female (-0.0349), and Employment Growth*Breadwinner (0.1764) indicate (1) that a native domicile with a higher employment growth rate tended to be more capable of attracting back repeat migrants, and (2) that this attraction was weaker for females but stronger for breadwinners. The negative coefficient of Rural Unemployment Rate*Breadwinner (-0.2395) shows that the re-migrated breadwinners were less likely to return to the native domiciles with higher unemployment

rates. As indicated by the positive coefficient of Household Income Differential (0.0107), repeat migrants were also more likely to return to the native domiciles with higher income levels. The positive coefficients of Local Government Expenditure Per Capita (1.0476) and its interaction with Service Sector Worker (0.3836) show that a native domicile with relatively high local government expenditure per capita that presumably created more jobs in the service sector tended to have a stronger ability to attract repeat migrants, especially those who were service workers. Furthermore, the coefficients of Ln(Non-agricultural Share of Total Employment) (0.6142) and its interactions with Service Sector Worker (0.3908) and Agricultural Worker (-3.0743) suggest that a native domicile with a higher proportion of employment in non-agricultural sectors was more able to attract repeat migrants, especially the service sector workers, but it tended to repel the repeat migrants who were agricultural workers. This finding suggests that the similarity between a prefecture's industrial structure and the repeat migrants' job-specific skills enhanced its ability to attract return migrants.

The best return/onward model also shows that return migrants also responded in a rational way to ***the economic restructuring and globalization*** in the late 1980s. The coefficients of World City (-0.5828) and its interactions with College (0.6226) and University (0.8240) indicate that among Taipei City's departed natives who decided to re-migrate, the less educated were discouraged from returning, whereas the better educated, especially those with university education, were encouraged to return. The positive coefficient of World City Suburban (0.2589) suggests that the re-migrating natives of Taipei Hsien were more prone to return. The large positive coefficient of Science Park (0.8593) indicates that the re-migrating natives of Hsinchu City were highly prone to be attracted back by the new opportunities generated by the expansion of high-tech industries.

Table 6.4. The Observed and Predicted Proportions of Return In-migrants in the Labor Force Aged 25-29 by Marital Status and Sex, Education, Breadwinner Status, Industry, Occupation, and Origin: Based on the 1990 Population Census, Taiwan.

Personal Characteristics	Return In-migrants Volume (Persons)	Composition (%)	Proportion of Return In-migrants (%) Northern Taiwan: Taipei City	Taipei Hsien	Hsinchu City	Central Taiwan: Taichung City	Taichung Hsien	Southern Taiwan: Kaohsiung City	Kaohsiung Hsien	Other Major Cities	Other Rural Prefectures
					(Observed)						
Total	26,511	100 0	6 8	11 7	1 4	2 6	6 5	3 6	6 2	9 8	51 4
1. Male											
Single	6,828	51 0	6 2	10 8	1 1	1 8	5 2	2 8	5 1	7 5	59 5
Married	6,382	47 7	5 7	13 0	1 3	2 6	7 5	3 6	5 9	10 2	50 2
Div/Sep	160	1 2	4 4	10 6	0 0	1 9	5 6	2 5	6 9	5 6	62 5
Widowed	14	0 1	7 1	7 1	0 0	0 0	7 1	0 0	7 1	14 3	57 1
2. Female											
Single	3,254	24 8	9 1	9 3	1 0	2 3	4 9	3 4	5 8	8 0	56 2
Married	9,301	70 9	7 3	12 4	1 9	3 2	7 5	4 3	7 3	11 9	44 2
Div/Sep	502	3 8	6 2	9 4	1 8	2 0	6 0	2 6	7 0	10 8	54 4
Widowed	70	0 5	8 6	5 7	0 0	1 4	5 7	4 3	12 9	15 7	45 7
3. Education											
Primary	2,144	8 1	3 5	13 2	0 7	1 7	5 8	2 1	6 6	7 7	58 7
Junior High	6,960	26 3	4 0	11 1	1 1	1 9	6 1	2 7	6 3	8 3	58 4
Senior High	10,075	38 0	7 5	12 6	1 4	2 9	7 2	4 3	6 7	10 6	46 9
College	4,078	15 4	8 6	11 7	1 8	3 2	6 6	3 7	6 0	10 5	47 9
University	3,254	12 3	10 4	8 9	2 1	2 8	5 9	4 0	4 7	11 4	49 8
4. Breadwinner Status											
Breadwinner	7,604	28 7	9 4	16 6	1 7	3 1	7 4	5 1	6 2	11 9	38 5
Non-breadwinner	18,907	71 3	5 8	9 7	1 3	2 3	6 2	2 9	6 3	9 0	56 6
5. Industry											
Primary	1,920	7 3	0 7	2 6	0 4	0 4	5 7	1 0	7 0	5 4	76 8
Secondary	11,163	42 7	5 1	13 8	1 8	2 0	7 1	3 2	6 6	10 3	50 0
Tertiary	13,052	49 9	9 1	11 4	1 2	3 3	6 2	4 2	5 8	10 2	48 6
6. Occupation											
Professional	3,485	13 7	7 9	9 5	2 2	2 4	6 4	4 0	5 9	11 0	50 8
Managerial	141	0 6	14 2	16 3	0 7	3 5	7 1	2 1	4 3	8 5	43 3
Low-skilled	3,909	15 4	2 5	11 3	0 9	1 4	6 2	2 6	5 9	8 9	60 3
Others	17,883	70 4	7 2	12 0	1 4	2 7	6 6	3 7	6 5	9 7	50 2
*7. Origin**											
Most Urbanized Areas	14,432	54 4	8 8	13 6	1 0	0 9	6 7	1 5	7 1	8 4	51 9
Other Major Cities	2,476	9 3	5 2	9 9	0 6	1 3	2 3	2 4	4 8	3 5	70 0
Rural Prefectures	9,603	36 2	4 3	9 1	2 2	5 3	7 3	7 0	5 3	13 7	45 8
					(Predicted)						
Total	26,269	100 0	6 5	12 3	1 1	3 0	5 7	3 3	5 6	8 6	54 0
1. Male											
Single	6,648	50 0	6 9	12 1	0 9	3 1	5 8	3 1	5 3	8 1	54 7
Married	6,473	48 7	5 3	12 5	0 9	3 2	5 8	3 2	5 5	8 7	54 8
Div/Sep	154	1 2	6 8	10 9	1 1	2 8	5 2	3 6	5 3	9 1	55 2
Widowed	17	0 1	4 8	3 5	0 8	2 0	7 7	0 0	4 3	10 4	66 4
2. Female											
Single	3,622	27 9	8 3	13 0	1 0	3 0	6 1	3 5	5 2	8 9	50 8
Married	8,795	67 8	6 3	11 9	1 2	2 9	5 5	3 3	6 2	8 5	54 2
Div/Sep	496	3 8	6 2	14 1	1 3	2 8	5 2	3 4	6 2	10 5	50 4
Widowed	64	0 5	8 2	7 9	0 6	1 8	4 4	3 0	7 2	9 6	57 3
3 Education											
Primary	2,126	8 1	4 0	12 2	0 6	2 1	4 0	2 4	6 3	6 4	62 0
Junior High	6,801	25 9	4 3	11 4	0 7	2 3	5 0	2 7	5 7	7 6	60 3
Senior High	9,868	37 6	6 0	13 9	1 1	3 2	6 0	3 6	5 7	9 0	51 6
College	4,128	15 7	8 7	11 9	1 4	3 8	6 6	3 6	5 4	9 3	49 4
University	3,346	12 7	11 3	10 2	1 5	3 6	6 3	3 8	5 3	9 8	48 4
4. Breadwinner Status											
Breadwinner	7,395	28 2	7 7	16 7	1 2	3 5	5 7	4 1	5 4	10 1	45 6
Non-breadwinner	18,874	71 8	6 0	10 6	1 0	2 8	5 7	3 0	5 7	8 0	57 2
5. Industry											
Primary	1,896	7 4	1 2	4 9	0 4	1 1	5 2	1 2	6 5	4 1	75 4
Secondary	11,067	43 0	5 1	13 3	1 1	2 8	5 7	3 0	5 8	8 9	54 4
Tertiary	12,787	49 7	8 6	12 5	1 1	3 5	5 7	3 9	5 3	9 0	50 3
6. Occupation											
Professional	3,308	45 6	8 6	9 9	1 3	3 5	6 0	3 9	5 9	9 3	51 5
Managerial	174	2 4	8 6	19 0	1 5	4 0	7 4	3 7	3 0	9 4	43 4
Low-skilled	3,766	52 0	3 3	11 2	0 7	2 0	4 8	3 0	6 0	7 8	61 1
Others	17,670	243 8	6 7	12 7	1 1	3 1	5 7	3 2	5 6	8 5	53 4
*7. Origin**											
Most Urbanized Areas	14,303	54 4	8 8	15 3	1 0	1 4	6 4	1 5	5 7	8 7	51 1
Other Major Cities	2,745	10 4	4 6	14 7	0 5	1 4	2 7	2 5	5 6	4 4	63 7
Rural Prefectures	9,221	35 1	3 5	6 9	1 2	6 0	5 5	6 2	5 6	9 7	55 4

* See Table 6 2

The best return/onward model also suggests that the repeat migrants' propensities to choose the return option were also affected by the quality of life, housing opportunities, and population size in the native domicile. The coefficients of Population Density (-0.1514) and Housing Growth (0.2730) show that these propensities were weakened by a high population density and strengthened by a high housing growth. The positive effect of Ln(Population Size) (0.3525) shows that the return propensities were enhanced by the population size of native domicile. Also, note that the negative coefficient of Inclusive Variable (-0.3575), which is properly bounded between 0 and -1, indicates that the perceived utility of making onward migration had the expected negative effect on the propensities to choose the return option.

Additional insights are revealed by the distribution of return migrants into different destinations (Table 6.4). In general, return migrations were mainly ***urban-to-rural*** in orientation, with 52% of returnees ended up in rural prefectures. Note that the most urbanized areas were the major origins of the largest return flows, mainly because they had a relatively high non-native share of population. Also, it is worthy of stressing that triggers of ***urban-to-rural return migrations*** were highly related to the disappointment and location-specific capital left in the native domiciles, whereas ***rural-to-urban*** and ***urban-to-urban*** return migrations were largely induced by labor market forces. Since those with better education tend to be more capable of taking the opportunities in the labor market, it is not surprising that the shares of return migrants by Taipei City as a destination increased strongly with education (from 3.5% at the primary level to 10.4% a the university level), whereas the corresponding shares by rural destinations tended to decrease with education (from 58.7% and 58.4% at the primary and junior high levels to 47.9% and 49.8% at the college and

university levels). Note that return migrants received by Taipei City were also strongly over-represented by breadwinners and professionals/managers.

6.6 Findings from the Onward Destination Choice Model

Estimation of the onward destination choice model is based on the 31,817 observations representing 39,339 onward migrants in the labor force aged 25-29 (in 1990). The estimation results of the best model are shown in Table 6.5, with the observed and predicted destination choice proportions of onward migrants by a set of explanatory variables being summarized in Table 6.6. Since the Rho-square of the best model is as high as 0.2426 and the predicted figures in Table 6.6 provide a good fit[12] of the observed ones, the best onward destination choice model thus fits the data well.

The best model shows that onward migrants were ***very responsive to the labor market factors*** of destinations. The highly positive coefficient of Employment Growth (0.3325, compared with 0.0772 in the return/onward model) indicates that onward migrants were very strongly attracted to prefectures with higher employment growth rates. The positive coefficients of its interactions with Professional/Managerial (0.1103) and Non-world City*Low-skilled Labor (0.0819) suggest that this attraction was even stronger for professionals and managers, and for low-skilled laborers who went to prefectures other than Taipei City. However, the highly negative coefficient of its interaction with Female (-0.2814) shows that female onward migrants, whose repeat migrations were mainly due to marriage, were much less subject to its positive effect.

---

[12] Because the best onward destination choice model does not contain much information on the effects of marital status and sex, the predicted figures by marital status and sex thus do not fit the observed ones very well.

Table 6.5. Estimation Results of the Destination Choice Model for the Non-native Onward Migrants in th Labor Force Aged 25-29: Based on the 1990 Population Census, Taiwan.

Explanatory Variable	The Best Model		Change in Rho-square
	Coefficient	t-ratio	
1. Effects of Relative Location			0.0842
Ln(Distance to Potential Destination)	-0.5085	-46 0	
Ln(Distance to Potential Destination)*At-least College	0.1913	16.7	
Contiguity	0.3574	10.3	
Contiguity*Married	0.1754	5.6	
2. Effect of the Size of Ecumene			0.0390
Ln(Population Size)	1.3478	63.2	
3. Effects of Quality of Life			0.0062
Population Density	-0.1014	-12.2	
Housing Growth	0.4778	20.7	
Ln(Housing Cost)*Married	-1.1630	-17.8	
4. Effects of Labor Market Variables			0.0157
Effects of Employment Structure			
Ln(Non-agri. Share of Total Employment)	2.0519	15.6	
Ln(Non-agri. Share of Total Employment)*Agricultural Worker	-4.7498	-14.5	
Ln(Non-agri. Share of Total Employment)*Service Sector Worker	1.0591	6.9	
Effects of Employment Growth			
Employment Growth	0.3325	16.1	
Employment Growth*Female	-0.2614	-14.2	
Employment Growth*Professional/Managerial	0.1103	2.4	
Employment Growth*Non-world City*Low-skilled Labor	0.0819	5.6	
Effect of Unemployment			
Unemployment Rate*Low-skilled Labor	-0.1783	-4.3	
Effects of Household Income Differential			
Household Income Differential*College	0.0090	2.2	
Household Income Differential*University	0.0170	3.8	
Effects of Local Finance			
Local Government Expenditure Per Capita	0.7043	10.2	
Local Government Expenditure Per Capita*Service Sector Worker	0.5270	17.0	
5 Effects of World City			0.0018
World City	-0.6704	-13.1	
World City*College	0.5594	7.1	
World City*University	0.9460	11.6	
6 Effects of World City Suburban			0.0002
World City Suburban*Primary Education	0.1519	2.2	
World City Suburban*Junior High	0.1935	4.7	
7. Effect of Science Park			0.0048
Science Park	0.2648	3.3	
Science Park*College	0.5739	4.6	
Science Park*University	1.7985	18.3	
Rho-square	0.2426		

Somewhat more important than total employment growth were ***the level and expansion of employment in non-agricultural***, especially the service sector. The highly positive coefficient of Ln(Non-agricultural Share of Total Employment) (2.0519, compared with 0.6142 in the return/onward model) indicates that onward migrants were also strongly attracted to the prefectures with a high proportion of the employment in non-agricultural sectors. The coefficients of its interactions with Service Sector Worker (1.0591) and Agricultural Worker (-4.7498) show that this attraction was particularly strong for service workers, but became reversed for agricultural workers. The positive coefficients of Local Government Expenditure Per Capita (0.7043) and its interaction with Service Sector Worker (0.5270) suggest that prefectures which had a relatively high local government expenditure per capita and presumably created more jobs in the service sector tended to have a stronger ability to attract onward migrants, especially those who were service workers.

Mainly due to its explanatory power ***overlapping*** with those of several other explanatory factors such as Non-agricultural Share of Total Employment and Local Government Expenditure Per Capita[13], the income level of destination turned out to have limited attractive power in the multivariate context. The positive coefficients of the interactions of Household Income Differential with College (0.0090) and University (0.0170) indicate that the onward migrants with college and especially university education were

---

[13] The explanatory powers of World City, Science Park, Population Size, and Housing Growth also overlapped substantially with that of Household Income Differential. For example, when World City is removed from the best model, the coefficients of Household Income Differential*College and Household Income Differential*University are increased substantially from 0.0090 and 0.0170 to 0.0280 and 0.0556, respectively. The associated t-values are also increased drastically from 2.2 and 3.8 to 11.1 and 21.3, respectively.

subject to the attraction of destination income level. Unemployment rate, which had little interprefectural variation, also turned out to have a limited effect. The negative coefficient of Unemployment Rate*Low-skilled Labor (-0.1783, t=-4.3) shows that low-skilled onward migrants tended to avoid going to the prefectures with a relatively high unemployment rate.[14]

In a highly selective way, onward migrants were very responsive to ***the effects of economic restructuring and globalization***. The positive coefficients of Science Park (0.2648) and its interactions with College (0.5739) and University (1.7985) indicate that Hsinchu City, with a highly successful large-scale Science Park, was attractive to onward migrants, especially those with college and university education. The coefficients of World City (-0.6704) and its interactions with College (0.5594) and University (0.9460) suggest that Taipei City discouraged the settlement of less educated onward migrants (especially those with less than college education) but encouraged the entry of university-educated onward migrants. The positive coefficients of the interactions of World City Suburban with Primary Education (0.1519) and Junior High (0.1935) suggest that Taipei Hsien was attractive to the less educated onward migrants, including those who got a job in Taipei City but could not afford the city's high housing cost.

Onward migrants were also sensitive to the quality of life in their choices of destinations. The highly significant coefficients of Population Density (-0.1014, t=-12.2), Housing Growth (0.4778, t=20.7), and Ln(Housing Cost)*Married (-1.1630, t=17.8) suggest

---

[14] The relative weak explanatory power in the multivariate context is partly due to the overlap of its explanatory power with that of Population Size, because these two explanatory factors are negatively correlated. When Population Size is deleted from the best model, the coefficient of Unemployment Rate*Low Skilled Labor is changed from -0.1783 to -0.4450, and the associated t-value is changed from -4.3 to -11.5.

that the young adult onward migrants tended to avoid destinations with high population density and to select destinations with increasing housing opportunities, and that they were less prone to settle in the prefectures with high housing cost, if they became married.

As expected, the destination choice behaviors of onward migrants were subject to the strong effects of distance and contiguity. The coefficients of Ln(Distance to Potential Destination) (-0.5085) and its interaction with At-least College (0.1913) indicate that the distance to potential destination had a negative effect, which was weaker for the better educated. The coefficients of Contiguity (0.3574) and its interaction with Married (0.1754) show that onward migrants, especially those who got married, were more prone to move to a neighboring than a non-neighboring prefecture. Compared with the corresponding research on the primary labor migration (see Chapter 5), onward migrants were less subject to the distance-decay effect and more prone to select a neighboring prefecture. These contrasts reflect (1) that onward migrants, who had experienced at least one migration before, tended to have a ***broader information field*** than primary migrants, and (2) that a high proportion of onward migrations were probably triggered by ***housing relocations*** (which spilled over to a neighboring prefecture), following a job-oriented long distance migration.

Destination population size also had a very strong positive effect. In fact, the very strong attraction of destination population size to onward migrants was due to (1) that population size was positively associated with employment growth rate and income level, and negatively related to unemployment level, and (2) that Taipei Hsien, the most populous prefecture of Taiwan, absorbed the most number of onward migrants.

Table 6.6. The Observed and Predicted Destination Choice Proportions of Onward In-migrants in the Labor Force Aged 25-29 by Marital Status and Sex, Education, Breadwinner Status, Industry, Occupation, and Origin : Based on the 1990 Population Census, Taiwan.

Onward In-migrants			Destination Choice Proportion of Onward In-migrants (%)								
Personal Characteristics	Volume (Persons)	Composition (%)	Northern Taiwan			Central Taiwan		Southern Taiwan		Other Major Cities	Other Rural Prefectures
			Taipei City	Taipei Hsien	Hsinchu City	Taichung City	Taichung Hsien	Kaohsiung City	Kaohsiung Hsien		
			(Observed)								
Total	39,339	100 0	19 6	31 5	2 5	6 3	5 6	6 8	5 7	12 8	9 1
1. Male											
Single	9,623	44 7	23 4	32 1	3 1	5 8	5 0	5 9	5 6	11 1	8 0
Married	11,727	54 4	13 6	33 2	1 9	6 7	7 0	7 1	6 7	14 3	9 5
Div/Sep	190	0 9	16 8	31 6	2 1	6 8	9 5	11 1	3 7	11 1	7 4
Widowed	12	0 1	16 7	16 7	0 0	0 0	16 7	8 3	8 3	8 3	25 0
2. Female											
Single	5,052	28 4	33 2	28 9	2 5	6 1	3 5	5 7	4 4	9 3	6 5
Married	12,158	68 4	17 1	30 8	2 7	6 4	5 6	7 5	5 4	14 2	10 4
Div/Sep	520	2 9	13 8	26 0	1 3	7 3	6 7	10 2	4 2	17 3	13 1
Widowed	57	0 3	8 8	22 8	5 3	5 3	1 8	8 8	7 0	14 0	26 3
3. Education											
Primary	2,421	6 2	10 1	32 5	1 6	5 1	8 3	6 5	6 5	15 0	14 4
Junior High	7,979	20 3	11 6	34 9	1 1	6 0	7 3	7 0	7 4	14 3	10 3
Senior High	13,785	35 0	17 5	31 8	1 2	6 7	6 1	7 7	6 8	13 1	9 0
College	7,390	18 8	23 5	30 6	2 3	7 0	4 8	6 5	5 1	12 2	8 0
University	7,764	19 7	30 8	27 9	6 7	5 5	3 1	5 6	2 2	10 8	7 4
4. Breadwinner Status											
Breadwinner	17,385	44 2	17 7	31 9	2 1	6 8	6 1	7 3	6 1	13 3	8 7
Non-breadwinner	21,954	55 8	21 1	31 2	2 8	5 9	5 3	6 5	5 3	12 5	9 4
5. Industry											
Primary	632	1 6	7 0	13 0	0 5	6 0	8 2	9 8	7 6	12 3	35 6
Secondary	15,423	39 7	14 0	34 5	3 1	5 2	6 9	6 1	6 8	14 9	8 5
Tertiary	22,836	58 7	23 7	30 1	2 2	7 0	4 8	7 2	4 9	11 4	8 7
6 Occupation											
Professional	7,467	20 1	23 4	27 5	6 4	5 7	3 9	6 6	4 0	13 0	9 6
Managerial	350	0 9	24 0	31 7	2 0	7 7	5 7	7 1	6 3	9 7	5 7
Low-skilled	4,276	11 5	8 6	37 7	1 1	4 5	7 8	6 0	8 7	15 4	10 2
Others	25,088	67 5	20 1	31 6	1 6	6 6	5 9	7 0	5 8	12 5	9 0
*7. Origin**											
Most Urbanized Areas	24,297	61 8	19 5	35 1	2 7	4 4	6 2	4 0	7 6	12 6	7 9
Other Major Cities	2,992	7 6	26 3	23 6	2 4	4 2	2 8	7 8	2 5	10 2	20 2
Rural Prefectures	12,050	30 6	18 1	26 2	2 2	10 6	5 1	12 3	2 6	14 1	8 7
			(Predicted)								
Total	39,581	100 0	20 7	30 4	2 5	6 6	4 6	6 8	4 3	12 7	11 5
1. Male											
Single	9,712	45 0	22 8	32 0	2 6	7 8	4 5	6 5	3 7	11 6	8 5
Married	11,636	54 0	17 5	28 9	2 3	7 3	5 4	7 1	5 1	14 6	11 8
Div/Sep	196	0 9	20 2	32 9	1 4	8 0	5 1	7 3	3 8	12 1	9 3
Widowed	17	0 1	22 3	30 9	2 1	7 8	4 9	7 8	3 7	11 4	9 2
2. Female											
Single	4,775	26 5	26 9	32 3	2 8	5 5	3 4	6 4	3 2	10 0	9 4
Married	12,664	70 3	19 6	29 8	2 5	5 3	4 4	6 8	4 4	12 9	14 2
Div/Sep	526	2 9	21 0	34 1	1 4	6 1	4 4	7 4	3 6	10 9	11 1
Widowed	55	0 3	20 6	32 3	1 4	6 7	4 3	8 7	3 4	10 9	11 8
3. Education											
Primary	2,439	6 2	17 3	28 8	1 2	6 6	5 2	7 0	4 9	14 9	14 1
Junior High	8,138	20 6	16 8	31 5	1 2	6 8	5 1	6 9	4 9	14 3	12 5
Senior High	13,992	35 3	16 1	32 7	1 3	6 7	4 9	7 3	5 0	13 6	12 5
College	7,340	18 5	23 9	28 9	2 3	6 8	4 4	6 9	3 8	12 0	10 9
University	7,672	19 4	31 1	27 1	6 5	5 8	3 5	5 6	2 7	9 4	8 1
4. Breadwinner Status											
Breadwinner	17,594	44 5	19 4	30 3	2 3	7 1	4 9	6 9	4 5	13 3	11 2
Non-breadwinner	21,987	55 5	21 7	30 5	2 6	6 2	4 3	6 7	4 1	12 2	11 7
5. Industry											
Primary	656	1 7	6 9	20 8	1 1	4 7	7 5	3 9	9 2	11 4	34 6
Secondary	15,702	40 3	15 4	32 1	2 1	6 4	5 5	5 9	5 0	14 8	12 7
Tertiary	22,587	58 0	24 9	29 4	2 7	6 8	3 9	7 5	3 7	11 3	9 9
6. Occupation											
Professional	6,744	59 6	28 0	26 9	4 4	6 3	4 0	6 5	3 5	10 5	10 0
Managerial	338	3 0	17 2	35 3	3 2	6 0	4 8	5 6	4 0	13 4	10 5
Low-skilled	4,227	37 4	13 4	32 0	1 3	6 4	6 3	6 6	5 2	15 9	13 0
Others	26,032	230 2	20 2	30 7	2 1	6 7	4 5	7 0	4 4	12 7	11 7
*7. Origin**											
Most Urbanized Areas	24,573	62 1	22 7	36 2	2 5	4 3	4 4	3 3	4 1	13 1	9 2
Other Major Cities	3,232	8 2	24 0	25 2	2 0	6 8	4 3	9 6	4 2	9 6	14 3
Rural Prefectures	11,776	29 8	15 5	19 8	2 5	11 2	5 1	13 2	4 7	12 7	15 3

* See Table 6 2

The distribution of onward migrants into different destinations, as shown in Table 6.6, reveals some further insights. In sharp contrast to the strong urban-to-rural orientation of return migrants, the flows of onward migrants were characterized (1) largely by the ***inter-urban*** and (2) partly by the ***rural-to-urban*** moves. Note that only 9.1% of onward migrants but as many as 51.4% of return migrants ended up in rural prefectures. Another important feature of the destination choice pattern of onward migrants was that most of onward migrants chose only ***a few highly urbanized destinations***, particularly the Taipei Metropolitan Area. As many as 78.1% of onward migrants and only 38.8% of return migrants ended up in the three major metropolitan areas (Taipei, Kaohsiung, and Taichung). Note that the Taipei area absorbed as many as 51.1% (19.6% for Taipei city and 31.3% for Taipei Hsien) of onward migrants and only 18.5% (6.8% for Taipei city and 11.7% for Taipei Hsien) of return migrants.

Moreover, the educational selectivity in the distributions of onward migrants into different types of destinations was also consistent with the multivariate findings in the sense that the responses of onward migrants to the economic restructuring and globalization in the late 1980s were highly selective by educational attainments. Taipei City's share of onward in-migrants increased from less than 20% at lower levels of education to 23.5% at the college level and 30.8% at the university level. Similarly, Hsinchu City's share of onward in-migrants increased from less than 2% at lower levels of education to 2.3% at the college level and 6.7% at the university level.

6.7 Conclusion

By applying a three-level nested logit model to a multidimensional tabulation of the full records of the 1990 Taiwanese census, we have identified behaviors and major determinants of the 1985-90 migration of young non-native labor force in Taiwan. We have also found supports for both disappointment and responsiveness hypotheses as well as the effects of Taiwan's patriarchal value system.

A strong support for the disappointment hypothesis was shown by the positive effect of previous migration distance (i.e. distance to native domicile) in the departure model. Its U-shaped effect in the return/onward model not only supported the disappointment hypothesis, but also revealed its effects on the depreciation of location-specific capital and on the ability to finance a repeat migration. Other supports for this hypothesis were that the return/onward ratio was a negative function of educational attainment, and that agricultural workers were particularly prone to re-migrate from prefectures with a high proportion of total employment in non-agricultural sectors.

Although the non-natives disappointed with the outcome of previous migration were more prone to make return migration, returnees were still subject to the effects of labor market forces in a rational way and were also responsive to the economic restructuring and globalization of the late 1980s. In general, prefectures of native domicile with better economic opportunities were more capable of getting back their departed natives, although more than 50% of return migrants ended up in rural prefectures. Among the re-migrating natives of Taipei City (the command center of Taiwan's economic system), the better educated were encouraged to return, whereas the less educated were discouraged to do so. The re-migrating natives of Hsinchu City (Taiwan's Silicon Valley) were highly prone to be

attracted back by the expansion of high-tech industries and other industries.

The destination choice behaviors of onward migrants showed very strong supports for the responsiveness hypothesis. Compared with return migrants, onward migrants were much more responsive to labor market forces, especially to employment growth. In response to the economic globalization, the best educated onward migrants were strongly attracted by Taipei City, whereas those with less education were more prone to head for its suburban prefecture, Taipei Hsien. Responding to the economic restructuring, the non-natives were also attracted to Hsinchu City in a highly selective way: very strong at the college level and extremely strong at the university level.

Repeat migration of the non-natives was also affected by Taiwan's patriarchal value system. Being assigned with the major responsibility of improving family economic well-being within this value system, breadwinners were (1) more prone to migrate onward, (2) less prone to return, and (3) more responsive to the pushes and pulls of market forces than were non-breadwinners. Due to the structure of patrilineal family, change in marital status had a stronger effect on the re-migration propensities of females than on those of males.

The overall conclusion of this chapter is that migrations of the young adult non-natives were highly responsive to the labor market forces. Even the return migrants, who were more prone to be disappointed with the outcome of previous migration and were less adaptive to the changing economic circumstances, were shown to respond to these forces in a rational way. Therefore, the corresponding policy implications are twofold. First, as a natural outcome of market adjustment, the responsiveness of repeat migrations to the market forces has the effect of promoting market efficiency, suggesting that there is no need to

intervene such a process. Second, to reduce unnecessary repeat moves triggered by disappointment, the policy measure should be designed to facilitate those less capable of processing market information, mostly the less educated.

Chapter 7

Determinants of Fast Repeat Migrations of the Labor Force: Evidence from the Linked National Survey Data of Taiwan

7.1 Introduction

Labor migration is an important process for matching the demand and supply in the spatial labor market. It may serve the purpose of improving the economic well-being of workers and the productivity of the economic system. However, the prevalence of fast repeat migrations (defined operationally in this chapter as the re-migrations that take place within a year after the previous migration) suggests the low efficiency of this process, because fast return migrations quickly cancel out the previous migrations, whereas fast onward migrations inflate the costs of moving to desired destinations in a roundabout way. Thus, for formulating an effective policy to improve the efficiency in the functioning of the labor market, it is important to have an in-depth understanding of fast repeat migrations.

Another important reason for studying fast repeat migrations is that the selectivity in them is likely to be quite different from the selectivity in non-fast migrations. Based on an analysis of the PSID (Panel Study of Income Dynamics) data, Morrison and DaVanzo (1986) found that among the fast repeat migrants, the return migrants differed sharply from the onward migrants with respect to several key personal attributes: the former were less well educated, less likely to have salaried professional and managerial occupations, and more likely to be unemployed before the previous migration. In contrast, they found that among

the non-fast repeat migrants, the return and onward migrants did not differ significantly with respect to these personal attributes. The knowledge of such differences between fast and non-fast migrations is essential to the proper interpretation of the information obtained from the migration data that do not allow a clear distinction between these two types of migrations (e.g. the five-year migration data from American and Canadian censuses).[1]

The analysis of fast repeat migrations is a relatively new field in demography, although demographers have been aware of the prevalence of repeat migrations, at least indirectly, since the late 19th Century when Ravenstein (1889) reported from his analysis of the British census data that each main stream of migration was accompanied by a large counter-stream. The importance of repeat migrations as a factor in high mobility rate was highlighted several decades ago by Goldstein (1958). However, an in-depth investigation of fast repeat migrations was hindered by the lack of suitable data until the late 1960s and early 1970s when detailed micro data files with some temporal depth became available through either specifically designed surveys or the linkages of administration records of successive years (Lansing and Mueller, 1967; Morrison, 1971). The new findings from these data stimulated the development of the theories on repeat migrations in the mid-1970s and early 1980s (Yezer and Thurston, 1976; Allen, 1979; DaVanzo, 1981; Herzog and Schlottmann, 1983).

To achieve an in-depth and broad understanding, it is important to test the hypotheses derived from these theories against various types of data taken from different countries. So

---

[1] For example, to the extent that fast return migrations occur more frequently among disappointed workers, the income gains of migration computed from the five-year migration data of the censuses tend to be inflated.

far the multivariate tests of the hypotheses about fast repeat migrations have been conducted on only a few data sets of the United States and Canada (DaVanzo, 1981 and 1983; Grant and Vanderkemp, 1986). Perhaps with the exception of the widely-used longitudinal data from the PSID, most of these data sets have shortcomings that are serious enough to cause the researchers to warn that their empirical findings are at best suggestive.[2] It is certainly very important to find alternative data sets to continue the empirical investigation.

The main objectives of this chapter are (1) to identify the determinants of job-related fast repeat migrations of the individuals in the civilian labor force of Taiwan, and (2) to examine whether the effects of these determinants are largely consistent with the existing theories and with the findings of other empirical studies. Our study is based on the linked micro data of the annual national migration surveys of Taiwan from 1980 through 1989.

The organization of this chapter is as follows. In section 7.2, we review the main theories of repeat migrations and formulate a set of hypotheses that can be tested against the Taiwanese data. Our data and statistical method are described in section 7.3. The empirical findings are presented in section 7.4. The main points are summarized in section 7.5.

---

[2] The longitudinal data set of Canada used by Grant and Vanderkamp (1986) was constructed from the linkages of income tax records of successive years and hence does not contain the important information on educational attainment. The 1966-67 panel data file of the Survey of Economic Opportunity used by Morrison (1971) does allow the distinction between residential moves and migrations in 1967, because the survey did not follow the movers to their 1967 locations. The Social Security Continuous Work History Sample used by Morrison (1971) only shows the locations of the employers (instead of the locations of employees) so that an inter-county relocation of a firm was taken as an inter-county migration of the firm's employees. In the widely-used PSID file, families with relatively low income are over-represented.

7.2 Theories and Hypotheses

It has been pointed out by Grant and Vanderkemp (1986) that a repeat migration can happen in many different ways. It can occur when the outcome of the previous migration turns out to be disappointing or sub-optimal. It can be part of a person's preplanned arrangement (e.g. returning home after finishing college; returning to a university after a sabbatical leave). It can also result from an unforeseen change of circumstance (e.g. the migrations back to the Atlantic region of Canada from Alberta when Alberta's economic base was suddenly undermined by the sharp decline in oil price in the early 1980s). In some cases, it may not be the result of the decision made by the migrant (e.g. a soldier being transferred from one military base to another; an engineer returning from a short-term project contracted by his company; a prisoner being released from an overcrowded jail). Some repeat migrations may simply reflect the migrants' psychological trait of preferring new living environments. However, it seems that the job-related fast repeat migrations of the members of the civilian labor force are mainly generated by either (1) the disappointment in the outcome of a previous migration or (2) the attraction by a better job opportunity elsewhere.

There are two somewhat overlapping major theories that are particularly useful for studying fast repeat migrations: one is attributed to Yezer and Thurston, the other to DaVanzo and Morrison. Although these theories are not very comprehensive, they serve the important purposes of generating testable hypotheses and suggesting the key questions to be asked in migration surveys. The negative results from the testing of the hypotheses can also help the refinement, extension, or reformulation of the theories.

7.2.1 The Yezer-Thurston Theory

The Yezer-Thurston theory is an extension of the human capital theory (Sjaastad,

1962) by adding (1) the realistic assumption of imperfect information and (2) a job search theory to account for repeat migration (Yezer and Thurston, 1976). The theory explains the previous migration as an outcome of a potential migrant's maximization of the present values of her/his expected future income streams among a set of places, which are net of the sum of the moving cost, the differential in psychic income between origin and destination, and the search cost. Due to the imperfection of the information used in the previous migration, it is possible that the destination chosen by a migrant may turn out to be disappointing or sub-optimal. The theory then explains repeat migration as an outcome of the adjustment process at the destination, whereby the migrant revises his expected wage and search duration. Depending on the relative wage levels of alternative places, he may decide to stay put or make a repeat migration (back to the origin or onward to a third place).

This theory was extended somewhat by Allen (1979) who pointed out that the perceptions of psychic income can also be affected by imperfect information so that the migrants who overestimate psychic income at the new destination are also more prone to make a repeat migration. It was also extended by Herzog and Schlottmann (1982) and Grant and Vanderkemp (1985) who further divided onward (i.e. non-return repeat) migrations into backward and forward types, according to the relative distances of the second destination to the origin and the first destination.

This theory has been used to generate various hypotheses about the factors of repeat migration, mainly via their impacts on the quality of the information used in the decision-making process. These factors include the distance of the previous migration, the number of previous migrations, the educational attainment and age of the migrant, and the migrant stocks in difference regions (Herzog and Schlottmann, 1983).

7.2.2 The Da Vanzo-Morrison Theory

The Da Vanzo-Morrison theory of repeat migrations is based on two central concepts: information costs and location-specific capital. "*Information is not costless and uncertainty is a fact of life*" (DaVanzo, 1981, p. 47). A potential migrant will only continue to collect information as long as the benefit is perceived to be greater than the cost. Thus, the information used as the basis for the previous migration may be imperfect and hence may result in disappointment. The disappointment may in turn trigger a repeat migration.

Location-specific capital is defined as any factor that ties a person to a particular place (e.g. home ownership, a job-related asset like an existing clientele, seniority, non-vested pension, knowledge of an area, and a kinship and friendship network). It has the property of being immovable or highly expensive to move from one location to another. It also has the property of (1) taking substantial amounts of time or money to build up at a location and (2) depreciating with an increase in the duration of absence. A repeat migration may occur when a recent migrant is drawn by the location-specific capital of one of the places he/she used to live.

This theory allows the generation of various hypotheses about the factors of repeat migration, via their impacts on the information costs and the location-specific capitals in different places. Since information cost is closely related to information imperfection, most of the hypotheses that can be generated by the Yezer-Thurston theory can also be generated by this theory. Based on the notion of location-specific capital, this theory can also generate additional hypotheses about the effects of such factors as the duration of stay at a previous residence, the duration of absence from a previous residence, and occupation (DaVanzo, 1981).

7.2.3 Additional Considerations: Budget Constraint and Societal Context

An important matter that has not been incorporated in these two theories is the financing of migration and of the subsequent adjustments. The previous migration may have used up a large portion of the migrant's savings so that he/she may not be able to finance another migration soon. Since going into debt need not be readily acceptable, tight budget constraints may have significant impacts on the feasibility and selectivity of fast repeat migrations. The ways to overcome budget constraints may depend on not only the migrant's willingness to become a debtor but also the existence and diversity of lenders.

The difficulty in financing fast repeat migrations may differ between societies as well as among individuals. Our personal observations suggest that people in Taiwan are in general less willing to go into debt and more dependent on informal lending sources such as relatives and friends than are the Americans. This difference suggests that the way to overcome the budget constraint should be incorporated into the theories of the fast repeat migrations.

To understand the selectivity in fast repeat migrations in Taiwan, it is also useful to consider them in a general societal context in which the labor market forces are constrained and facilitated by the traditional value system and government policies. The government's active promotion of married women's labor force participation since the late 1960s and the continued domination of the patriarchal ideology in Taiwan have resulted in not only a significant increase in the married women's share of labor force but also a strong differentiation between men's and women's expected roles in the labor market (Hsiung, 1996). The general expectation of a family in Taiwan is that men are the major income-earners, whereas women serve not only as household keepers but also as secondary income-

earners when an employment opportunity exists.[3] Another important influence of the patriarchal system lies in its ability in producing docile young adult females who are particularly preferred by certain industries (e.g. electronics) whose production requires high precision and cleanliness. Most of the jobs for these females in these industries are dead-end jobs and contribute to their high job mobility. Because occupational career is not a primary concern, the females often retreat from the labor market after marriage or giving birth. The implications of this societal context on repeat migration propensities will be discussed under Hypothesis 9 in the next section.[4]

7.2.4 The Hypotheses

Based on the existing theories as well as our knowledge of the Taiwanese society, we

---

[3] A program used by the government to create job opportunities for the married women in Taiwan was the so-called "Living-rooms-as-factories" Program (Hsiung, 1996). Many living rooms were indeed turned into simple "factories" in the 1970s. In the meantime, numerous so-called "satellite factories" were built in urban neighborhoods and rural villages, providing job opportunities to both females and males at low wages. Being at the bottom of an export-oriented manufacturing system, the cheap labor of the married women in these factories became a contributing factor for the Taiwanese "economic miracle". The labor force participation rate of married women increased from 27.2% in 1967 to 42.7% in 1988, whereas that of single women increased from 57.3% in 1967 to 62.3% in 1973 and then decreased to 54.6% in 1988 (Hsiung, 1996, p. 40). In the 1990s, the rapid increase of foreign workers in Taiwan seemed to have contributed to a recent trend of the decreasing number of Taiwanese married women involved in the industrial homework.

[4] As a consequence of the greater availability of better migration data for developing countries in recent years, the importance of the influences of cultural systems on migration behaviors has become increasingly clear. For example, in the patriarchal system of Zimbabwe, the main burden of farmwork falls on females so that the urban-to-rural migration rates of females remain very high through all working ages, whereas the corresponding rates of males are much lower through all working ages and then increase sharply at the end of wage work (Liaw and Hayase, 1997). Failure to control for the effects of cultural systems on migration behaviors may result in a careless rejection of sensible theories that are derived from the assumption of rational behavior.

now derive a set of hypotheses that can be tested on the Taiwanese data.

Hypothesis 1: The propensity of fast repeat migration is a convex function of the previous migration distance: it first increases and then decreases as the distance increases.

The positive relationship in this hypothesis is based on the idea that the reliability of the information used in the previous migration is a decreasing function of the distance from the previous origin. With less reliable information, the potential migrants in a more distant place are more likely to form erroneous expected wages at potential destinations. The so-called *pessimists* who underestimate the expected wages are more prone to stay put, whereas the so-called *optimists* who overestimate the expected wages are more likely to out-migrate. Thus, the migrants from more distant places are more likely to be over-represented by the optimists, who upon arrival are more likely to be disappointed and hence more prone to make a repeat migration (Yezer and Thurston, 1976). The negative relationship in this hypothesis occurs when the information effect becomes overwhelmed by the direct cost effect. Due to budget constraint, the longer the distance of the previous migration is, the less is the remaining budget available for covering the direct cost of a fast repeat migration[5].

Hypothesis 2: The convex effect of the previous migration distance on the propensity of fast repeat migration is mainly shaped by its convex effect on the propensity of fast onward migration.

The main reason for this hypothesis is that the negative effect of budget constraint

---

[5] It was pointed out by Allen (1979) that the effect of the previous migration distance on the incidence of repeat migration can be "ambiguous", because the direct cost effect may or may not be weaker than the information effect. The 1960 census data of the United States used by Yezer and Thurston (1976) and DaVanzo (1976) suggest that on the repeat migrations back to the region of birth, the information effect was stronger than the direct cost effect.

is likely to be weaker for fast return migrations than for fast onward migrations, because the increasing negative effect of budget constraint at an increasing distance to the destination of return migration (which is likely to be the home place) can be countered by the positive effect of the help from the kinship and/or friendship network there. Another reason is that the fast return migration propensity is likely to be rather insensitive to the negative effect of distance, because both the knowledge of the opportunities at the previous residence and the location-specific capital left there are unlikely to vary with the previous migration distance, especially after only one year's absence.

Hypothesis 3: The propensity of fast repeat migration is a convex function of the number of previous moves: it increases with the number of previous moves at a decreasing rate. The shape of this function comes mainly from the convex effect of the number of previous moves on the propensity of fast onward migration.

There are two main reasons for the positive relation in this hypothesis. First, migration is a "learning-by-doing" process. The frequency of previous moves tends to increase (1) the skill in gathering and assessing information on the opportunities of other potential destinations for future migration, (2) the number of locations where some location-specific capitals have been left behind, and (3) the capacity to adapt to new circumstances. These effects in turn increase the propensity of fast onward migration directly and the propensity of fast repeat migration indirectly. Second, the number of previous moves may reflect the strength of a person's psychological predisposition to enjoying new environments.

The positive effect of the previous number of moves can be partially weakened by the negative effect of the budget constraint, which becomes increasingly important as the

number of previous moves increases[6]. The budget constraint reduces the feasibility of making too many migrations within a short time interval. Since fast return migrants can benefit from the help of the kinship and friendship network at the origin of the previous migration, the negative effect of the budget constraint is greater on fast onward migration than on fast return migration.

Hypothesis 4: The duration of unemployment at the chosen destination has a positive effect on both the propensity of fast repeat migration and the propensity of fast return migration.

The previous migrants with a longer duration of unemployment are more likely to recognize that their economic failure was due to their overestimation of the expected wage of the chosen destination (rather than a short-term transitional problem). Consequently, they are more likely to reduce their expected wage of the chosen destination and hence increase their probability of making a fast repeat migration. Since the individuals with longer durations of unemployment are in general more likely to have exhausted their financial resources and are less able to adjust to new labor markets, their fast repeat migrations are more likely to be oriented toward their previous residence where they may be sheltered and assisted by the kinship/friendship net work.

Hypothesis 5: Relative to employers and the self-employed, employees are more prone to make repeat migrations.

Since employees tend to possess less location-specific capitals that are essential to running a successful business, they tend to suffer less from a disappointing migration. Thus,

---

[6] Another reason for the decreasing positive effect of the previous number of moves is that the migrants who have made more moves are more likely to have found an "optimum" place to settle down and are hence less likely to move again.

they tend to be less careful in gathering and assessing the information for making the previous migration and are hence more likely to make fast repeat migration as a corrective measure. Furthermore, due to the difference in location-specific capital, when there is a mismatch between employers and employees, the latter are more likely to move than the former.

Hypothesis 6: The previous migrants whose reason was to look for a job are more prone to make a repeat migration than those whose reason was job change/transfer.

The previous migrants whose reason was to look for a job were more likely to have migrated before a job was secured, whereas those whose reason was job change/transfer were more likely to have a job secured before migration. Therefore, the former are more likely to be disappointed and hence to make a fast repeat migration than are the latter.

Hypothesis 7: The level of education has a negative effect on the propensity of fast return migration.

Since the less educated individuals tend to be less capable of obtaining reliable information about the opportunities at potential destinations, they are more likely to experience post-migration disappointments and are hence more likely to be compelled to make a repeat migration. Since the less educated repeat migrants tend to have relative little information about the opportunities in locations other than their previous origin, their repeat migrations are more likely to be the return type. Therefore, educational attainment is expected to have a negative effect on the propensity of fast return migration.

Hypothesis 8: The single marital status has a positive effect on the propensity of fast repeat migration.

The previous migrants who are single are more prone to make fast repeat migrations

for several reasons. First, they tend to have relatively low cost of migration so that they are less affected by the negative effect of budget constraint. Second, being without children, they do not have to worry about the negative effects of fast repeat migrations on school-age children. Third, being alone, they can be easily accommodated in the homes of their parents, if the next job site is close to their parental homes.

Hypothesis 9: Due to the influence of the strong patriarchal ideology, the Taiwanese men and women have substantially different levels and age patterns in their propensities to make fast onward migrations.

Under the patriarchal system, men as major income-earners are more likely to behave like "maximizers" whose propensities to look for a "greener pasture" on an ongoing basis tend to remain relatively high through all working ages. In contrast, women as secondary income-earners are more likely to behave like "satisficers" whose propensities to make a fast onward migration tend to decrease with age. The young adult females under the patriarchal system are expected to have rather high propensities to make onward migrations, because of their high job mobility. With child-raising and housekeeping responsibilities, the women who have passed the late 20s are less likely to choose onward migration as a corrective measure when their wages or work conditions turn out to be less than optimal.

7.3 Data, Measurements, and Methodology

7.3.1 Data and Measurements

Our data source is the October-round of the monthly ***Survey of Human Resources (SHR)***, which contains the supplementary questions on the internal migration in Taiwan. These national surveys with the supplementary questions on migration were conducted by the Census Bureau of DGBAS (Directorate-General of Budget, Accounting and Statistics)

on an annual basis from 1980 to 1989.[7] With households as sampling units, these surveys followed a two-stage stratified sampling design with unequal weights, and the sample size for each survey was kept at about 0.4 percent of the current total population.

The questionnaire of each SHR asks for the information on the attributes of each sampled household and the personal characteristics of its members. In addition, the information on labor force factors like employment status and experience, industry, occupation, and working status are collected on the individuals aged at least 15. The supplementary questions on internal migration yield the migration information (e.g. the number of previous moves, reasons for moving, previous and current places of residence) as well as additional labor force information prior to and after the move for those who ever moved during the past one year.

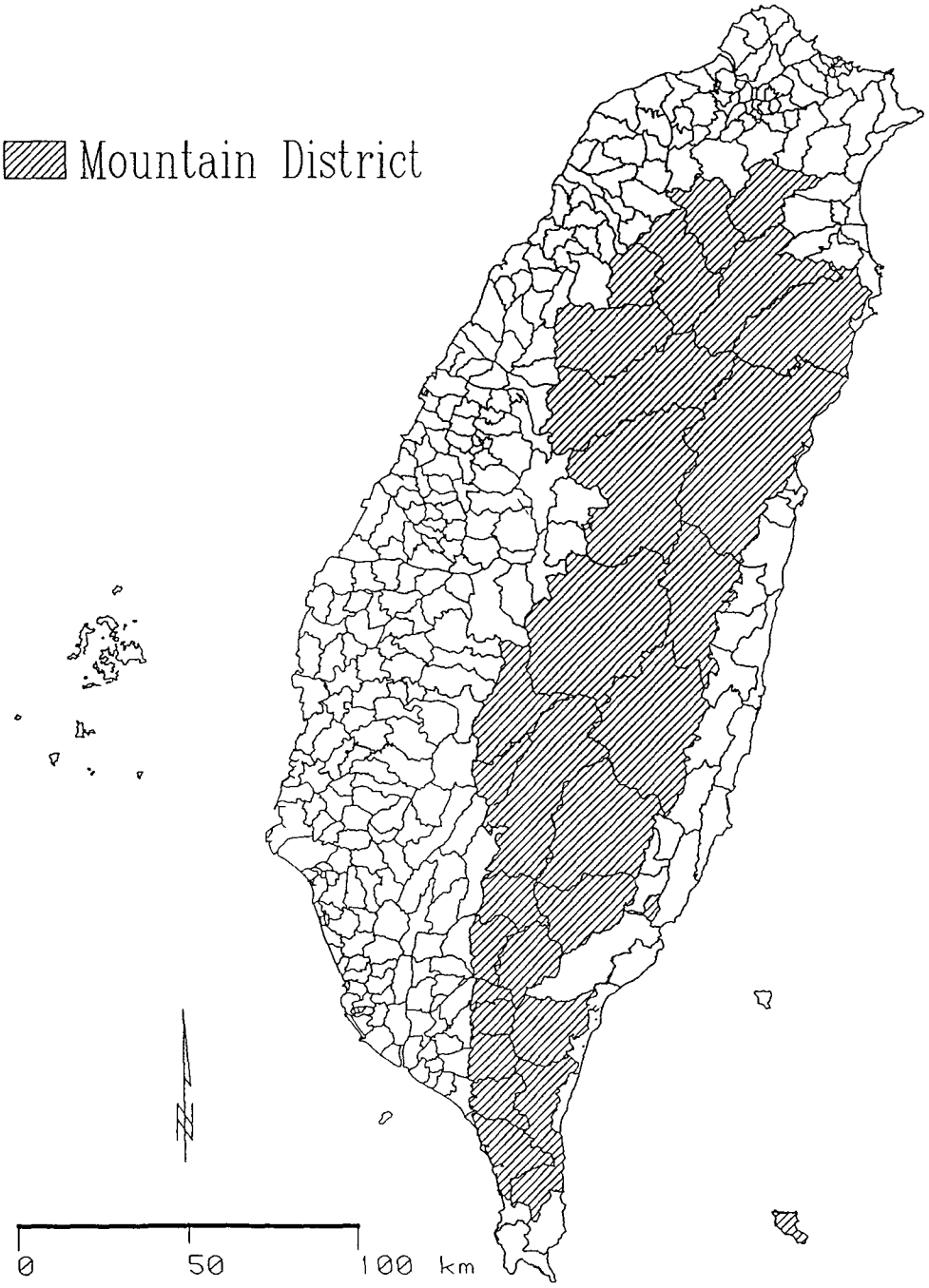
The geographic units we use to define migration are the 336 low-level administrative districts which cover the whole territory of Taiwan (Figure 7.1). A migration is defined in this study as a relocation of residence crossing at least one district boundary.[8]

---

[7] The SHR did not include the supplementary questionnaire on migration in 1990, because the 1990 census was supposed to provide adequate migration information. To reduce cost, the supplementary questionnaire on migration was attached to the SHR only once every three years since 1992.

[8] We use the 1992 boundaries of these 336 administrative districts. In general, the number of and the boundaries of these low-level administrative districts have been very stable over time.

Figure 7.1. The Administrative Districts of Taiwan used to Define Fast Repeat Migrations.



We link the individual records of successive years to generate the information for determining the fast repeat migration status. Since about half of the sampled households of each survey remained in the succeeding survey, only about half of the individual records in the two consecutive surveys can be linked. The linkage is based on the ID and geographical coding of each household, together with the age and sex of the household members. Since the sampling scheme does not allow any household to be surveyed for more than two consecutive years, the linkage of records for three or more years is impossible.

Since we are interested in the fast repeat migrations of the individuals in the labor force, we further restrict our sample to include only those who were aged 15-64 and ever migrated due to job-related reasons[9] in the first-year of the linked two-year period. We further exclude those whose second (intra- and inter-district) moves were due to education, housing or marriage, because the moves due to these reasons are not directly related to the theories of interest in this chapter. The resulting sample contains 2,583 "previous migrants". Note that the previous migration status is based on positive answers to the following two questions in the questionnaire of the first year: Have you ever moved in the last 12 months? Was your previous residence in a different administrative district?

For each previous migrant, the migration status in the second year is determined by comparing the current district of residence of the second survey (l), the current district of residence of the first survey (k), and the district of residence in the 12 months before the first survey (j). If l is not equal to k and j, then the individual is a "fast onward migrant". If l is not equal to k but is equal to j, then the individual is a "fast return migrant". A "fast repeat

[9] Job-related reasons for migration in the survey questionnaire fall into two broad categories: job-transfer/change and job-seeking reasons.

migrant" is either a fast onward migrant or a fast return migrant. A "stayer" is a previous migrant who is not a fast repeat migrant.

7.3.2 The Statistical Model and Methodology

The statistical model is the polytomous logit model used by DaVanzo (1983) and Grant and Vanderkamp (1986). For each previous migrant (i), the probability of choosing an alternative (A) is explained by the following model:

$$(1) \qquad P_i(A) = \frac{e^{V_{Ai}}}{\sum_{A' \in C} e^{V_{A'i}}} \quad , \quad with \quad V_{Ai} = B_A X_{Ai} \quad , \quad A \in C;$$

where $P_i(A)$ is the probability of choosing alternative A from the choice set C which includes the options of fast return migration, fast onward migration, and staying put; V_{Ai} is the utility of alternative A perceived by the ith previous migrant; B_A is a row vector of unknown parameters; and X_{Ai} is a column vector of observable explanatory variables. With "staying put" being the reference alternative, the first two variables in X_{Ai} are alternative-specific dummy variables representing the alternatives of "fast return migration" and "fast onward migration", respectively. The remaining variables in X_{Ai} are the interactions (i.e. products) of these alternative-specific dummy variables and the substantive explanatory variables (e.g. the dummy variables representing college and university education, respectively).

With the dependent variable in our input data matrix being the sample weight attached to each observation, we use the maximum quasi-likelihood method to estimate the unknown parameters (McCullagh 1983; Liaw and Ledent 1987). Whether a parameter has

significant effect is determined by its associated t-value (i.e. the estimated parameter divided by its estimated asymptotic standard error). Since our linked data consist of over 2,000 observations, the associated t-value can be regard as a standard normal variate. To avoid artificially inflating the t-values, we scale the sample weights so that their sum is identical to the number of observations in the sample.[10]

The goodness-of-fit of a specification of the model is measured by the Rho-square statistic:

(2) $\quad Rho\text{-}square = 1 - L / L_o;$

where L is the maximum quasi-loglikelihood of the specification in question, and L_o is the maximum quasi-loglikelihood of the null model (i.e. the model that possesses only the two dummy variables representing the return and onward alternatives, respectively). Note that this statistic is bounded between the floor of zero and the ceiling much less than one such that a value of 0.2 can represent a very good fit (McFadden, 1974).

---

[10] The original weights were set at a level that will allow the sum of weights be equal to the size of the underlying population (i.e. the total labor force of Taiwan). If these weights were directly used in the estimation procedure, the magnitudes of the t-values would be artificially inflated. To avoid the artificial inflation, users of the SAS LOGISTIC and CATMOD procedures should also scale the sample weights so that their sum is made to be equal to the sample size. Instead of CATMOD, we use our own GAUSS program which can handle a much larger data set. Our MQL method and the IRLS (iterative reweighted least squares) method used in LOGISTIC and CATMOD procedures yield the same estimated values for the unknown coefficients. The asymptotic covariance matrices yielded by these two methods differ by the multiplication of a scalar that approaches 1 as the sample size approaches infinity. Because our sample size is very large, these two estimation methods yields practically the same covariance matrix and hence the same t-values.

We call the specification with all relevant explanatory variables as the "general model". By removing most of the statistically non-significant variables from the general model, we obtain the so-called "best model".[11] To evaluate the relative importance of two subsets of explanatory variables, we delete each subset in turn from the general model and observe the resulting decreases in the log of quasi-likelihood. In each deletion, the decrease in the log of quasi-likelihood has an asymptotic Chi-square distribution, with the degrees of freedom being the number of explanatory variables in the deleted subset. The p-value implied by the Chi-square statistic can then be used to judge the relative importance of the deleted subset: the smaller the p-value, the more important the subset.

7.3.3 The Explanatory Factors

The explanatory factors used to test our hypotheses are as follows. For simplicity, the terms "first year" and "first survey" will be used in the rest of the chapter to mean the first year and the first survey of a linked two-year period. The terms "second year" and "second survey" also refer to the later half of the same linked two-year period. The terms "he" and "his" represent "he/she" and "his/her", respectively. The distinctions in each categorical explanatory factor are represented by one or more dummy variables.

(1) ***Distance of Previous Migration***: For each person, this factor is the Euclidian distance in kilometers between geographic centers of (1) his current district of residence in the first

---

[11] Because of the large sample size, we consider a magnitude of 1.96 for a t-value as an indication of statistical significance (at the 0.05 level). The "best model" is defined as the specification that contains all the statistically significant variables and two nearly significant variables. With slightly smaller t-values (-1.8 and -1.9), the interaction terms (Senior High*Return, and College*Return) are retained in the "best model", because their coefficients, together with that of At-least University*Return, have a substantively meaningful pattern (Table 7.1).

survey and (2) his district of residence before the previous migration[12].

(2) ***Number of Previous Moves***: For each stayer, this factor is his number of moves in the previous 12 months reported in the first survey; for each fast repeat migrant, this factor is the sum of (1) his number of moves in the previous 12 months reported in the first survey and (2) his number of moves in the previous 12 months reported in the second survey subtracted by 1.

(3) ***Duration of Unemployment***: For each person, this factor is his duration of unemployment (in weeks) reported in the first survey.

(4) ***Reason for the previous move***: With "job transfer/change" as the reference category, this factor is represented by a dummy variable, "Job Search", which assumes the value of 1 if the reason for the previous move was "looking for a job" reported in the first survey.

(5) ***Employment status***: With employer/self-employed/unpaid family worker as the reference category, this factor is represented for each person by two dummy variables, representing the employee and unemployed status, respectively.

(6) ***Level of Education***: With less than junior high school as the reference category, this factor is represented for each person by four dummy variables, representing respectively junior high school, senior high school, college, and at-least university reported in the first survey.

(7) ***Age***: For each person, this factor is the age (in years) determined by the month and year of birth reported in the first survey.

(8) ***Sex***: This factor is the sex reported in both surveys (female, male). To study the sex-

---

[12]However, in case a district falls into the category of officially-designated mountain district (see Figure 7.1), its associated population center instead of geographic center is used to calculate previous moving distance.

specific effects of age on migration choices, we define both Female and Male dummy variables and replace Age by Female*Age and Male*Age in the model (See footnote 13 for a detailed explanation of this way of specifying the explanatory variables).

(9) ***Marital Status***: This factor is the marital status reported in the first survey (single, married, divorced/separated, widowed).

(10) ***East-west Division by the Central Mountain Ranges***: Because it is very difficult and mostly impossible to move across this high and rugged mountain ranges which run from the northern extreme to the southern extreme, the Euclidian distance tends to understate the actual travel distance if the origin and destination are on different sides of it. Therefore, we introduce two dummy variables: (a) East-West, which assumes the value of 1 if the origin and destination of the previous migration are on different sides of the Central Mountain Ranges; and (b) Non-East-West, which is the complement of East-West. In our multivariate model, these two dummy variables are multiplied to the previous migration distance in order to control for the effect of this physical barrier.[13]

Finally, to allow for non-monotonic effect of a non-categorical explanatory factor (X) on the probability of choosing an alternative, we let the contribution of X to the utility function be expressed in the form of $A*logX + B*X$, where both A and B are unknown parameters. The shapes of this function are much more flexible than that of the commonly-

---

[13] Let X be distance, D be the East-West dummy variable, and R be the dummy variable representing the return option. There are two equivalent ways to generate EW and Non-EW distance effects on return migrations. First, we can use the form $b_1*X*R+b_2*(X*D)*R$, where b_1 and b_2 are unknown coefficients. Second, we can use the form $c_1*(X*D)*R+c_2*(X*(1-D))*R$, where c_1 and c_2 are unknown coefficients. The estimation results will guarantee that $c_1=b_1+b_2$ and $c_2=b_1$. We use the second way, because the estimated coefficients are easier to visualize. We also use the second way to estimate the distance effects on onward migrations and the sex-specific effects of age on both return and onward migrations.

used quadratic function. The qualitative properties of this function are as follows. First, if either A or B is zero with the other being non-zero, the effect of X is either positive or negative, depending on the sign of the non-zero parameter. Second, the effect of X is positive if both A and B are positive, whereas the effect of X is negative if both A and B are negative. Third, the effect of X becomes convex if $A > 0$ and $B < 0$, and concave if $A < 0$ and $B > 0$. Graphically, the shape of $A*logX + B*X$ is like that of the logarithm of the Gamma function.

7.4 Empirical Findings

Our linked data on the individuals of the Taiwanese civilian labor force who previously migrated for job-related reasons among the 336 districts of Taiwan reveal that fast repeat migrations were very common: as many as 18% of the previous migrants who had migrated for job-related reasons migrated again within a year for reasons other than pursuit of education, marriage, and housing considerations. If we do not impose a restriction on the reasons for the fast repeat migrations, the proportion is increased from 18% to 44%. Since much of this increase is accounted for by housing reasons, there seems to be a rather common phenomenon of a job-related move followed soon by a housing-related move.

Although the geographical units are not directly comparable, it is useful to mention the corresponding figures of Canada and the United States. Based on the linked income tax data of Canada, Grant and Vanderkamp (1984) found that among the 337 localities covering the whole country[14], 22% of those who migrated in 1968-69 did so again in 1969-70[15]. Based

---

[14] These 337 localities "cover all counties and census subdivisions as well as 100 major urban areas identified separately" (Grant and Vanderkamp, 1984, p. 65).

[15] By restricting the sample to those with continuous tax records for all the years in 1968-71, the Canadian data understated the migration level, because the sample

on the 1968-75 PSID longitudinal data of the United States, DaVanzo (1983) showed that 23% of the family heads who migrated among the 603 "labor markets" (229 Standard Metropolitan Statistical Areas and 374 State Economic Areas, covering the whole country) made a fast repeat migration.

Despite the fact that the population of each of the 336 districts represents only a very small fraction of the total population of Taiwan, we found that the fast repeat migrants were very strongly drawn back to the original district: 38% of the fast repeat migrants ended up as return migrants, suggesting the overwhelming importance of the location-specific capital in the original district that has not yet been depreciated by an extended period of absence. If no restriction is imposed on the reasons for the repeat migrations, this proportion is increased to an even higher value of 58%. In the above-mentioned Canadian and American Studies, the corresponding figures are 42% and 55%, respectively (Grant and Vanderkamp, 1984; DaVanzo, 1983).

The estimated results of the logit analysis are shown in the general and best models of Table 7.1. A comparison of the estimated coefficients in these two models shows that the explanatory powers of our chosen explanatory factors overlap to some extent. Note that the removal of non-significant explanatory variables from the general model to create the best model has caused the redefinition of the reference category of an affected factor. For example, the reference category of marital status has been changed from "Married" in the general model to "Married/Divorced/ Separated/Widowed" in the best model (Table 7.1).

"discriminates against new entrants into the labor market after 1966 as well as those leaving the labor force before 1971" (Grant and Vanderkamp, 1984, p. 64). In other words, more migratory individuals are more likely to be excluded from the sample.

To show graphically the functional forms of the effects of a non-categorical explanatory factor in the context of all other explanatory factors, we create a fictional 'mean person' whose values for the other explanatory factors are set at the sample mean.[16] For this mean person, we then vary the value of the explanatory factor in question to yield different predicted values for the probabilities of making fast repeat, onward, and return migrations, based on the estimated parameters in the best model. The resulting functional relationships are shown on Figure 7.2.

The best model provides statistically significant support for all of our hypotheses, with the support for Hypothesis 7 (educational effect) being partial (Table 7.1). The estimated rates of fast repeat migrations from the best model are mostly very close to the corresponding observed rates (Table 7.2). The main empirical findings are as follows.

Effect of Previous Migration Distance: For both types of previous migrations (non-east-west and east-west), we found (1) that the previous migration distance indeed had an convex effect on the predicted probability of fast onward migration, suggesting that the importance of budget constraint tended to increase with previous moving distance; (2) that the predicted probability of fast return migration remained at a low level through short and middle distances and showed an upward slope at very long distances, suggesting that due to the help of kin at the original home place, the negative effect of budget constraint was not strong enough to counter the disappointment effect. Being mainly determined by the shape

[16] For example, the mean of the dummy variable Job Search is 0.511, which means that 51.1% of the individuals in the sample had "job search" as their reason for the previous move. In evaluating the effects of the number of previous moves, the fictional "mean person" is somewhat more similar to those with the "job search" reason than to those with other reasons.

of the probability of fast onward migration, the shape of the probability of fast repeat migration turned out to be basically convex (Figure 7.2, panels A and B). Thus, Hypotheses 1 and 2 are confirmed.

Effect of the Number of Previous Moves: Our empirical results provide a strong support for Hypothesis 3. We found that the number of previous moves indeed had a very strong positive effect on fast onward migration, with the marginal effect becoming smaller as the number of previous moves becomes very large. Since its effect on fast return migration was very small, the shape of the probability of fast repeat migration was indeed mainly determined by that of the probability of fast onward migration (Figure 7.2,panel C).

Effect of the Duration of Unemployment: The predicted effect of the duration of unemployment on the propensity of fast repeat migration was indeed positive (Figure 7.2, panel D), as stated in Hypothesis 4. This positive effect resulted from the combination of (1) a strong positive effect on the propensity of fast return migration, and (2) a moderate negative effect on the propensity of fast onward migration.

Effect of the Employment Status: Relative to employers/the self-employed/unpaid family workers, employees were found in the best model to be significantly more prone to make both fast return and fast onward migrations (Table 7.1). Thus, Hypothesis 5 is confirmed. Although the unemployed were very similar to employees in terms of their observed rates of making fast return and onward migrations (Table 7.2), our multivariate analysis shows that unemployment status was not a significant factor in the context of unemployment duration (Table 7.1). When we deleted the unemployment duration from the general model, we found, however, that unemployment status turned out to have significant

positive effects on both return and onward migrations[17]. This is consistent with DaVanzo's (1983) finding from the PSID data that unemployment status had a significant positive effect on fast return migration and a nearly significant positive effect on fast onward migration. Thus, we have not only substantiated Da Vanzo's earlier finding about the effect of unemployment status but also shown that its effect on fast return migration increases sharply with the unemployment duration.

Effect of Reason for the Previous Migration: We found that 51% of the previous migrants migrated to look for jobs, suggesting that about half of the previous migrants migrated before securing a job. They indeed turned out to have higher rates of both return and onward migrations (8.3% and 13.1%) than those whose reason was job change/transfer (5.4% and 8.9%). In the best model, the effect of "looking for job" relative to "job transfer/change" is shown to have a significant positive effect on the propensity of fast return migration (Table 7.1). Thus, Hypothesis 6 is also confirmed.

Effect of Education: The estimated coefficients in the best model show that educational attainment had an increasingly negative effect on the propensity of fast return migration beyond the level of junior high school. Except for the similarly high tendencies of making return migrations among those with the lowest two levels of educational attainment, Hypothesis 7 is thus confirmed. We found that this negative effect became even more evident for those with at-least university education, who were seen to have an observed return rate of as low as 2.0%. In contrast, educational effect on fast onward migration turned out to be

[17] The coefficients of the interactions of unemployment status with the dummy variables representing the return and onward options became 0.89 and 0.92, after the unemployment duration was deleted from the general model of the model. The associated t-ratios became 1.9 and 2.3.

non-significant in the model (Table 7.1).

Table 7.1. Estimation Result of Multivariate Logit Model for Job-related Repeat Migration of Labor Force Aged 15-64: Based on the Linked National Survey Data of Taiwan.

Explanatory Variable	General Model		The Best Model		Relative Importance	
	Coefficient	t	Coefficient	t	P-value	Rank
I.Constant Terms						
Return Migration	-1 9746	-0 6	-5 4622	-8 6		
Onward Migration	-6 0269	-2 0	-6 7461	-6.6		
II.Effect of Personal Characteristics						
1. Age & Sex					9.1535E-06	2
Age of Males						
Male*Ln(Age/100)*Return	1.2964	0.9	-	-		
Male*(Age/100)*Return	-4 2702	-0.8	-	-		
Male*Ln(Age/100)*Onward	-2 5890	-2.0	-2 4621	-5 6		
Male*(Age/100)*Onward	7.2385	1.7	7.0789	4 8		
Age of Females						
Female*Ln(Age/100)*Return	1 3282	0 9	0 2088	2 0		
Female*(Age/100)*Return	-5.4251	-1.0	-	-		
Female*Ln(Age/100)*Onward	-3 2917	-2 8	-3.1387	-5.6		
Female*(Age/100)*Onward	0 0516	0 0	-	-		
2. Education(Ref.: at-most Primary Education)					1 3297E-02	5
Junior High*Return	-0 0556	-0 2	-	-		
Senior High*Return	-0 4266	-1 7	-0 3182	-1 8		
College*Return	-0 6866	-1 8	-0 6228	-1 9		
At-least University*Return	-1 6058	-2.7	-1 5182	-2 7		
Junior High*Onward	-0 1174	-0 5	-	-		
Senior High*Onward	-0 2827	-1.3	-	-		
College*Onward	0.1908	0 7	-	-		
At-least University*Onward	0 0960	0 3	-	-		
3. Marital Status(Ref.: Married)					1 3301E-02	6
Single*Return	0 6834	2 7	0 6574	3 1		
Divorced/Separated/Widowed*Return	-0.0316	0 0	-	-		
Single*Onward	0 5308	2 3	0 5364	2 5		
Divorced/Separated/Widowed*Onward	-0 3749	-0 5	-	-		
III. Labor Force Factors						
1. Employment Status(Ref: Employer/Self-employed/Family Worker)					7 7125E-04	4
Employee*Return	0.8395	2.5	0 8819	3 1		
Unemployed*Return	3 0524	1.1	-	-		
Employee*Onward	0 8847	2 9	0 8108	3 0		
Unemployed*Onward	4 2626	1 6	-	-		
2. Duration of Unemployment(Weeks)					1 3607E-02	7
Ln(No of Weeks/100)*Return	1.0056	1 1	-	-		
(No of Weeks/100)*Return	0.6409	0.1	5 7692	4 0		
Ln(No of Weeks/100)*Onward	0 8949	1 3	-	-		
(No. of Weeks/100)*Onward	-9 2361	-1.2	-0.2487	-2 0		
IV. Attributes of Previous Moves						
1. Previous Migration Reason (Ref.: Job Change/Transfer)					7 1360E-02	8
Return*Job Search	0 4139	2 2	0 3922	2 3		
Onward*Job Search	-0 0216	-0 1	-	-		
2. Previous Moving Distance(Kilometers)					5 7842E-04	3
Ln(Distance/500)*Non-eastward-westward Prior Move*Return	-0 4515	-2 8	-0 4634	-2 9		
(Distance/500)*Non-eastward-westward Prior Move*Return	3 4262	3 4	3 5376	3 6		
Ln(Distance/500)*Eastward-westward Prior Move*Return	-0 6649	-2 4	-0.6752	-2 5		
(Distance/500)*Eastward-westward Prior Move*Return	2 8299	2.1	2 9394	2 2		
Ln(Distance/500)*Non-eastward-westward Prior Move*Onward	0 5049	3.3	0.5008	3 3		
(Distance/500)*Non-eastward-westward Prior Move*Onward	-3 1123	-3 3	-3 0332	-3 3		
Ln(Distance/500)*Eastward-westward Prior Move*Onward	0 6808	2 6	0 6972	2 7		
(Distance/500)*Eastward-westward Prior Move*Onward	-2.5664	-2 1	-2.5216	-2 1		
3. No. of Moves in the Past Two Years					2 1581E-11	1
Ln(Previous Moves)*Return	1 9259	1.5	1 2275	4.1		
(Previous Moves)*Return	-0 4440	-0 6	-	-		
Ln(Previous Moves)*Onward	3 1648	3 3	1.6744	7 4		
(Previous Moves)*Onward	-0 8928	-1 6	-	-		

Note: reference alternative = staying

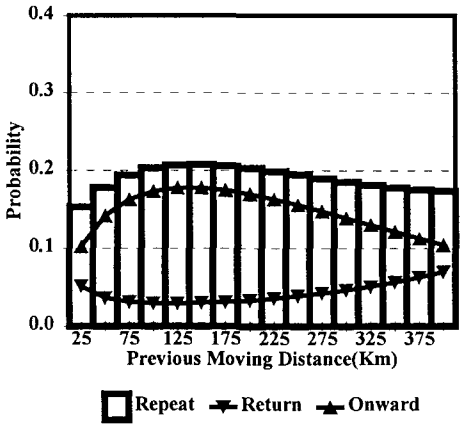
Table 7.2. Observed and Predicted Rates of Job-related Repeat, Return, and Onward Migrations for the Labor Force aged 15-64: Based on the Linked National Survey Data of Taiwan.

Variable	At-risk Population		Migration Rate(%)						Observed Odds	
	Size	Composition	Repeat		Return		Onward		Repeat /	Onward /
	(Persons)	(%)	Observed	Predicted	Observed	Predicted	Observed	Predicted	Stay	Return
Total	2,583	100.0	18 0	18 0	6 9	6 9	11.1	11 1	0.2	1 6
I. Personal Characteristics										
1. Sex										
Male	1,352	52 3	20.7	20 6	8 2	8.1	12.5	12.5	0.3	1.5
Female	1,231	47.7	15 0	15.1	5 5	5.6	9.5	9.5	0.2	1 7
2. Age(Male)										
15-19	305	22.6	29 1	29.0	11.1	10.8	18.0	18.2	0.4	1.6
20-24	364	26.9	19 8	22 3	6 0	9.1	13.8	13.2	0.2	2.3
25-29	336	24.9	22 3	17 8	10 3	7 1	12.0	10.7	0.3	1.2
30-34	158	11.7	8 0	13 8	4.6	5.6	3 4	8.3	0.1	0 7
35-44	114	8.4	16.0	12 9	6 9	5.1	9 1	7.8	0 2	1 3
45-64	74	5 5	17.4	17.1	6 5	6.7	10.9	10.4	0.2	1 7
3. Age(Female)										
15-19	414	33.6	24 9	25.4	5 7	7.1	19.2	18.3	0.3	3.4
20-24	384	31 2	16.9	14.4	9 3	6 0	7.6	8.4	0.2	0 8
25-29	248	20.2	4.8	6 9	1 8	3.9	3.0	3.0	0.1	1.7
30-34	96	7.8	3.7	5.2	2 6	3.8	1.1	1.4	0.0	0 4
35-44	49	4 0	0.0	3 8	0.0	3.2	0 0	0.6	0.0	-
45-64	40	3.2	4.6	3 2	4 6	3.0	0.0	0 2	0.0	0 0
4. Education										
At-most Primary	568	22 1	15 0	14.6	6 6	6.5	8.4	8 2	0.2	1.3
Junior/Senior High	1,649	64 0	19 4	20 1	7 6	7.7	11 8	12.4	0 2	1.6
College	196	7.6	19 1	16 2	5 8	5 8	13 3	10.4	0 2	2.3
At-least University	164	6.4	12.5	11 1	2 0	2.0	10.5	9 1	0.1	5 3
5. Marital Status										
Single	1,647	63.9	23.2	23 2	8 6	8 6	14 6	14.6	0 3	1 7
Married	871	33 8	8 8	8 8	3 8	3.8	5.0	5 0	0.1	1 3
Div /Sep /Wid	59	2 3	6 7	8 5	3 9	4 5	2.8	4.0	0 1	0 7
II. Labor Force Factors										
1. Employment Status										
Employer/Self-employed	195	7.5	4.8	7 1	2 1	2 9	2.7	4 2	0.1	1 3
Employee	1,956	75 7	21.1	21 1	7 9	7 9	13.2	13.2	0.3	1 7
Unemployed	122	4 7	20 9	19 8	8 6	8.6	12.3	11.2	0 3	1 4
Unpaid Family Worker	311	12.0	5 6	4 5	2 7	2.2	2.9	2.3	0.1	1 1
2. Length of Unemployment (Weeks)										
0-12	74	71 8	20 2	18 1	3 5	5.3	16.7	12 8	0.3	4 8
13-24	17	16 5	27 9	19 7	20 8	12.1	7 1	7 6	0.4	0.3
25+	12	11.7	35 7	38.2	30 5	32.8	5.2	5.4	0.6	0.2
III. Attributes of Previous Moves										
1. Previous Migration Reason										
Job Search	1,321	51.1	21 4	21.5	8 3	8.3	13.1	13.1	0.3	1.6
Job Change/Transfer	1,262	48.9	14.3	14.4	5 4	5.4	8.9	9.0	0.2	1.6
2. No. of Moves in the Past Two Years										
1	2,367	91.6	16 1	16 2	6.4	6.4	9.7	9 7	0 2	1.5
2	189	7.3	37 0	35 3	12 0	11.8	25 0	23 6	0 6	2 1
3+	27	1.1	51.8	56 6	13 2	14 9	38.6	41 7	1 1	2.9
3. Previous Moving Distance (Non-eastward-westward)										
0- 50	1,006	43.4	16 9	16 7	6 5	6 4	10 4	10 3	0 2	1 6
50-100	289	12.5	21 9	20 1	4.6	4.8	17 3	15 3	0.3	3 8
100-150	243	10.5	13 8	18 8	2.8	5.5	11.0	13.3	0 2	3 9
150-200	255	11.0	21.9	20 1	10 3	6 9	11.6	13.2	0 3	1 1
200-250	199	8.6	15 5	18.7	5 6	8.1	9.9	10 6	0 2	1.8
250+	327	14.1	19 4	17.6	10.9	10.3	8.5	7.3	0 2	0.8
4. Previous Moving Distance (Eastward-westward)										
0- 50	49	18.7	15 4	17.2	7 9	8.9	7.5	8 3	0 2	0 9
50-100	43	16.2	26.2	15.6	12 6	6.3	13.6	9 3	0.4	1 1
100-150	75	28.3	10 2	17 5	2.7	6.5	7.5	11 1	0.1	2 8
150-200	34	13.0	27 4	19 6	4 4	6.5	23 0	13.1	0.4	5 2
200-250	35	13.4	22 0	19 6	13.2	8 6	8.8	11.0	0 3	0.7
250+	28	10.4	12 7	18 4	7.1	8.1	5.6	10 3	0.1	0.8

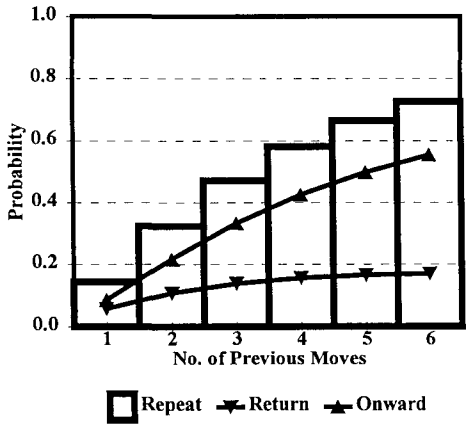
Figure 7.2. Predicted Probabilities of Fast Repeat, Return, and Onward Migrations of the "Mean Person".

A. Effect of Previous Moving Distance (Non-East-West Move)

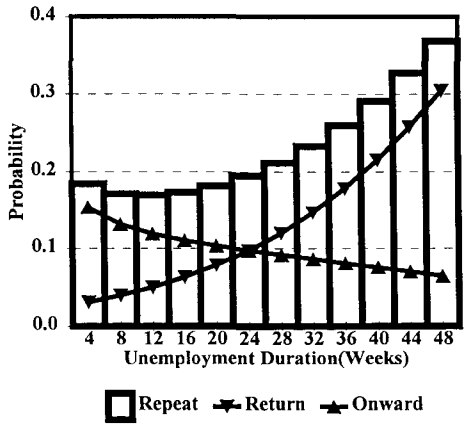
B. Effect of Previous Moving Distance (East-West Move)



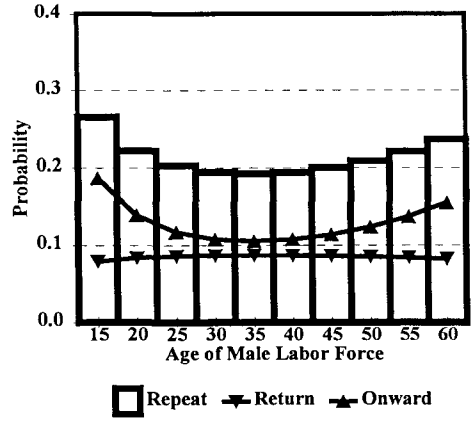
C. Effect of No. of Previous Moves



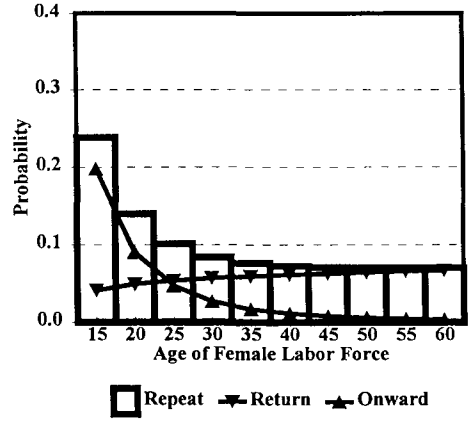
D. Effect of Unemployment Duration



E. Effect of Age for Male Labor Forc



F. Effect of Age for Female Labor Forc



Effect of Marital Status: With the married as the reference group, the estimated coefficients in the best model show that the singles were indeed far more prone to make both return and onward migrations than were those of other marital statuses (Table 7.1). Thus, hypothesis 8 is confirmed. The observed return and onward migration rates of the singles were 8.6% and 14.6%, which were much higher than the corresponding figures of the married (3.8% and 5.0%) and the divorced/ separated/widowed (3.9% and 2..8%).

Effect of Sex and Age: Our estimation result also shows that gender selectivity in fast repeat migrations was very strong in terms of both overall level and age pattern. Males were more prone to make both types of fast repeat migrations than females (Table 7.2). The patterns of the male and female onward migration schedules differed markedly: the former remained at a rather high level through all working ages and displayed a U-shaped pattern, whereas the latter declined sharply from a high level in the late teens to an extremely low level beyond the late 20s (Figure 7.2, panels E and F). In other words, beyond the late 20s, fast onward migrations became almost exclusively a male phenomenon. Thus, Hypothesis 9 is also confirmed.

Finally, we notice from the p-values in Table 7.1 that the factors with the greatest explanatory powers were (1) the number of previous moves, (2) gender and age, and (3) previous migration distance. Thus, the most salient features are (1) the strong positive effect of the number of previous moves on the propensity of onward migration, (2) the sharp contrast between male and female onward migration schedules, and (3) the strong convex effect of previous migration distance on the propensity of fast onward migration. In short, chronicity (Morrison, 1971), patriarchal ideology (Hsiung, 1996), and budget constraint appeared to be the most important underlying factors of the fast repeat migration behaviors

of the labor force in Taiwan.

7.5 Conclusion

Based on the theories of Yezer-Thurston and DaVanzo-Morison and our knowledge of Taiwan's societal context, we have derived a set of hypotheses about the effects of the experiences and personal attributes of the previous migrants in the Taiwanese labor force on their propensities to make fast repeat migrations. Using the linked micro data of the annual national migration surveys from 1980 through 1989 on the members of the labor force who were aged 15-64 and had migrated among the 336 districts of Taiwan due to job-related reasons, we have tested these hypotheses in a multivariate context by a polytomous logit model. The hypotheses are well supported by our empirical data. Our main findings are as follows.

The nature and outcome of the previous migration had significant effects on the propensities to make fast repeat migrations. First, mainly through the balance between its information effect and its direct cost effect, the previous migration distance had a strong convex effect on the propensity of making fast onward migration and a mild positive effect on the propensity of making fast return migration. The difference in the effects between the onward and return choices reflects the availability of greater location-specific capital (including the help from kin to reduce the negative effect of budget constraint) to the latter choice.

Second, mainly through the dominance of its "learning-by-doing" effect on its direct cost effect, the previous number of moves had a strong positive effect on the propensity of making fast onward migration, which remains positive even at six or seven moves.

Third, the duration of a previous migrant's unemployment had a strong positive effect on her/his propensity of making fast return migration and a moderate negative effect on her/his propensity of making fast onward migration so that the effect on the propensity of making fast repeat migration turned out to be positive. It was the prolonged unemployment duration, rather than simply the status of unemployment, that strongly enhanced the tendencies of making fast return migration.

Fourth, those whose previous migration reason was to look for a job were more prone to make a fast return migration than were those whose previous migration reason was job change/transfer. Since they had migrated before securing a job, the former were more likely to have disappointing labor market outcomes and hence were more prone to make a fast return migration.

Several personal factors also had significant effects on the fast repeat migration choices. First, employees and the unemployed were more prone to make fast repeat migration than were employers, the self-employed, and unpaid family workers, reflecting that the former had less location-specific capital to tie them down and were less careful than the latter in making the previous migration, probably because they had a lower adjustment cost when the expectation failed to materialize.

Second, the educational attainment of a previous migrant had a strong negative effect on the propensity of making a fast return migration but had no systematic effect on the propensity of making a fast onward migration. It is important to note that this finding is contrary to the common finding from census migration data that educational attainment has a strong positive effect on the propensity of making onward migration and has practically no effect on the propensity of making return migration (Long, 1988; Newbold and Liaw, 1994).

In light of the contrast between fast and non-fast repeat migrations revealed by Morrison and DaVanzo (1986), this difference is not surprising.

Third, we found that gender selectivity in fast onward migration was very strong in terms of both overall level and age pattern. Males were more prone to make both types of fast repeat migrations than females. The patterns of the male and female onward migration schedules differed markedly: the former remained at a rather high level through all working ages and displayed a U-shaped pattern, whereas the latter declined sharply from a high level in late teens to an extremely low level beyond the late 20s. This can be considered as a reflection of the strong dominance of the patriarchal ideology of the Taiwanese society.

In sum, our major findings on the fast repeat migrations from the Taiwanese data are mostly consistent with the previous findings from the North American data and provide additional evidence on the effects of budget constraint and patriarchal ideology. The most important underlying factors of fast repeat migrations in Taiwan appeared to be chronicity and patriarchal ideology. Since neither chronicity nor patriarchal ideology can be easily and quickly affected by policies, the basic features of fast repeat migrations may be rather resistant to policy measures, although our findings about the effects of educational attainment and unemployment duration on fast return migrations suggest that improvement in education and provision of information on job opportunities via such means as the internet can help reduce the level of unnecessary fast repeat migration.

It is useful to note that our data span the 1980s--a period of economic restructuring and globalization that had rather uneven impacts on different regions of Taiwan (Lin and Liaw, 1998). It seems that the high level of fast repeat migrations helped relocate labor quickly so that the unemployment rates of lagging regions remained at about the same low

level as those of the surging regions. To get a better sense about whether the fast repeat migrations were efficient, we plan to expand our data base by linking the socioeconomic attributes of the geographical units to the personal records so that we may assess whether the repeat migrants are strongly responsive to the pulls of the destinations with better economic opportunities. To ascertain the generality of the empirical findings, we recommend a similar analysis of the data for other periods (say, during an economic recession) and other countries.

Chapter 8

Conclusion

8.1 Introduction

As initially stated in Chapter 1, the main objectives of the thesis are (1) to explore the relationships between migration and socioeconomic changes in Taiwan, (2) to identify the characteristics and determinants of labor migration in Taiwan, and (3) to assess its impact on the quantity and quality of human resources in different regions of Taiwan, with an emphasis on the situations of the 1980s. These objectives have been pursued in three parts. Part One dealt with the first objective and was based on the literature on Taiwan's history and economic development as well as the time-series data on the demographic and economic conditions of Taiwan (Chapter 3). Part Two took advantage of the rich information in the full records of the 1990 census to achieve the second and third objectives (Chapters 4-6). Part Three used the 1980-89 linked micro data from the annual labor force surveys to provide further insights for the second objective (Chapter 7). The thesis has contributed to a better understanding of not only the labor migration process but also the settlement system of Taiwan.

The main findings on the labor migration in Taiwan are structured as follows. Section 8.2 summarizes findings on labor migration and the evolution of settlement system in Taiwan. Section 8.3 presents findings about the impact of labor migration on the spatial

pattern of human resources in 1985-90. Section 8.4 are findings on the characteristics and determinants of the 1985-90 labor migrations. Section 8.5 summarizes findings on fast return and onward migrations of the labor force. Section 8.6 contrasts the differences between the findings from the census and the linked migration data and offers a synthetical explanation of "why". Section 8.7 is the overall conclusion. Finally, the thesis ends up by offering four potential directions of future research in Section 8.7.

8.2 Labor Migration and the Evolution of Settlement System

Labor migration has been an important process in the development of Taiwan since the 17th century when the first large waves of immigrant laborers arrived in the Tainan area of southern Taiwan. Accompanying ***differential regional economic development***, the long-term trend of population redistribution has been ***northward,*** spreading from South Region to Central Region, and finally to North Region. Although South Region served as the original developmental hub, North Region finally became the most populous region by first becoming the new political center and then gaining the economic dominance. As for the last frontier of Taiwan, East Region, it was not until the 1920's that its regional population began to grow, mostly due to the inflows of agricultural cultivators through the encouragement of government policy.

The formation of urban economy since the late nineteenth century and ***the onset of industrialization*** in the 1930's laid the foundation of Taiwan's regional economy and settlement system, leading to the formation of ***three major regional economic centers***: the Taipei area for North Region, the Taichung area for Central Region, and the Kaohsiung area for South Region. By the end of the 1950s, labor migration was not voluminous at all, although it was mainly characterized as being rural-to-urban.

Mainly because of the economic takeoff and the successful establishment of export-oriented labor-intensive industries in the 1960s, the authentic ***massive rural-to-urban migration*** in Taiwan's history took place since the mid 1960s and lasted for about a decade, with most of the rural out-migrants ending up in the already populous Taipei area and the fast growing industrial Kaohsiung area. Meanwhile, the trend of eastward migration came to an end. Rural out-migrants (mostly primary migrants) contributed to the strengthening of the dual-pole pattern of Taiwan's spatial economy and settlement system.

Since ***the year of 1980***, important socioeconomic and political changes induced directly or indirectly systematic responses from labor migration and resulted in a major change in the settlement system. The settlement system shifted in the 1980s from the long-lasting ***dual-pole*** (north-south) concentration pattern developed since the 1930s toward a ***single-pole*** concentration pattern in northern Taiwan. There were two main reasons for this shift. First, with Taipei City being the corporate command center and Hsinchu City being developed as "Taiwan's Silicon Valley", the ability of North Region to retain its residents and to attract labor, particularly the better educated, from other regions was strengthened substantially. Second, mostly because of the inability of its regional economic center, the Kaohsiung area, to keep up with the trend of economic restructuring, South Region inevitably diminished in attractiveness. Therefore, such a distinguishing turnaround of population redistribution was an outcome of the spatially uneven impacts of the ***economic restructuring and globalization*** in the 1980s.

The descriptive analysis of the 1990 census has revealed the following salient features of labor migration in Taiwan. First, the labor markets of the four regions of Taiwan differed markedly. North Region was clearly a ***national labor market***. It had a very strong capacity

to retain its own native labor force and to draw large numbers of migrants from all of the remaining three regions. By contrast, Central and South Regions, though being highly industrialized, were ***regional labor markets***. There was little exchange of labor migrants between them, mainly because most of the jobs created in each of these two regions were taken by its native labor force and short-distance intra-regional migrants. The least industrialized East Region was changed from an agricultural settlement frontier to a very weak peripheral labor market: it was a net gainer of life-time migrants from Central and South Regions but a ***net loser of migrants to all other regions*** in 1985-90.

Second, ***the rural/peripheral prefectures*** in all four regions shared the same typical pattern as a "loser" in the exchange of migrants: a large net loss of primary migrants, countered by a small net gain of return migrants, and somewhat aggravated by a small net loss of onward migrants, implying the continuation of urbanization and a trend towards a more concentrated settlement pattern.

Third, the overall net migration rates of ***the three metropolitan core prefectures*** were quite different for different reasons: rather low for Taipei mainly because of a very strong suburbanization process; very high for Taichung partly because of a sudden housing boom; and very low for Kaohsiung mainly because of its inability to restructure its economy. North Region's massive net gain of migrants was absorbed mainly by two suburban prefectures (Taipei Hsien and Taoyuan Hsien), which had large net gains of both primary and onward migrants and small net losses of return migrants. The massive expansion in the suburban prefectures of the northern economic pole (Taipei) was in sharp contrast with the net loss of migrants in the suburban prefecture of the southern pole (Kaohsiung).

Fourth, the continuation of ***urbanization*** in the 1980s did not guarantee net gains of

migrants by all major cities. For example, with a weak or weakened economic base, two major cities (Chaiyi and Keelung) had net losses of all three types of migrants. In sharp contrast, as a reflection of national economic development policy in the 1980s, Hsinchu City benefitted substantially from the establishment of the country's first Science Park and had net gains of all three types of migrants, particularly the best educated.

8.3 Impacts of the 1985-90 Labor Migration on the Spatial Pattern of Human Resources

With the benefits of economic restructuring and globalization in the 1980s being mostly concentrated in North Region, the 1985-90 labor migration resulted in ***very efficient transfers of human resources*** into North Region from all of the remaining three regions. At either regional or prefectural level, ***primary labor migration*** played a much greater role than did onward and return labor migrations in these efficient transfers. The two main reasons for this difference were (1) that natives were more numerous than non-natives and (2) that non-natives were heavily concentrated in the highly attractive prefectures of North Region and hence did not have a strong intention to out-migrate.

Since primary migration showed a strong tendency of being ***positively selective*** with respect to educational attainment, a prefecture with a voluminous net gain of primary migrants (e.g. Taipei City) tended to experience a substantial improvement in the quality of its human resources, whereas a prefecture with most of its net loss being primary migrants (e.g. Taitung Hsien) tended to suffer a substantial deterioration. Consequently, ***labor migration aggravated the existing imbalance in the quantity and quality of human resources, although it served the role of increasing the efficiency of market adjustment in Taiwan.*** The greatest beneficiaries were Taipei City (the command center of the

internationalized Taiwanese economic system) and Hsinchu City (Taiwan's Silicon Valley). The main losers included not only all rural/peripheral prefectures but also the economically weakened major cities of Keelung and Chiayi.

However, two points are worthy of stressing. First, the losses in the quantity and quality of human resources due to migration ***did not*** result in socioeconomic declines within rural prefectures, because these losses were compensated for mainly by the ***rural-ward transfer of financial support*** from the central government and partly by the ***remittances*** sent back by rural out-migrants. Second, unlike the suburbanization process in North America which was typically selective of the upper class, leaving behind the lower class in the decaying central cities, the net gains of migrants in the attractive suburban prefectures of Taiwan ***did not*** exhibit positive educational selectivity so that labor migrations did not help improve the quality of human resources in suburban prefectures and contribute to the decay of central cities in Taiwan.

8.4 Characteristics and Determinants of the 1985-90 Labor Migrations

Based on the 1990 census, the non-native labor force were at least two times as migratory as their native counterparts, lending support to the idea that migration is a ***learning-by-doing process*** (i.e. previous migration tends to foster another migration) (Morrison 1971; Da Vanzo 1981). In addition to being more footloose, non-natives were more complex than natives in migration behaviors, mostly because of the relatively diversified personal characteristics of the former.

The behavioral similarities and differences among primary, return, and onward migrants can be summarized as follows. First, in terms of their responses to market forces, the behaviors of primary migrants were very similar to those of onward migrants, although

onward migrants were more complex than primary migrants in personal characteristics. Second, the reasons for making return migration were much more heterogeneous than the reasons for primary and onward migrations. Third, primary migration was dominated by ***rural-to-urban*** moves as opposed to the ***urban-to-rural*** orientation of return migration, while onward migration was largely ***inter-urban*** and partly rural-to-urban. Fourth, the triggers of ***rural-to-urban return migration*** were mainly the market forces, whereas ***urban-to-rural return migration*** was mostly due to the disappointment with previous migration and the pulling effect of location-specific capital left in the home region.

The ***major determinants*** of labor migration found from the 1990 census are summarized as follows. First of all, the strong ***patriarchal value system*** (Hsiung 1996) in Taiwan had a profound impact on the behaviors of labor migrations of either the natives or non-natives. At the time of change in marital status such as getting married or becoming divorced/separated, females were particularly more mobile than males. This value system also had led to the differential sensitivity to the market forces between breadwinners (mostly males) and non-breadwinners. Mainly because of assuming the responsibility of improving family economic well-being within this system, breadwinners were more responsive to the pushes and pulls of market forces than non-breadwinners.

Educational attainment, as a proxy for the ability (1) of making correct migration decision and (2) of obtaining and processing information, was also a very crucial determinant. Consistent with the findings from North America (Long 1988; Newbold and Liaw 1994), both primary and onward migrations were ***strongly*** selective of the better educated. Note that in Taiwan, the educational selectivity of primary migration was sharper than that of onward migration. By contrast, education was found to have a ***slightly negative***

effect on the propensity of return migration, partly because the census data had captured some incidences of fast return migration that were mostly selective of the less educated. However, it is important to note that although the less educated, particularly the natives, were less mobile than their better educated counterparts, the low-skilled labor force remained very responsive to the spatial variation in economic opportunities.

Labor migration in Taiwan was also extremely subject to the effect of ***location-specific capital*** (Da Vanzo 1981). For primary migration, agricultural workers were particularly subject to the strong retention effect of ***current*** location-specific capital than their non-agricultural counterparts. As for the migration of the non-natives, agricultural workers were much more mobile than non-agricultural workers. Mostly because of the pulling effect of location-specific capital ***left behind***, the agricultural non-native migrants were more prone to return than to move onward. Note that since the non-natives tended to have less location-specific capital than the natives, the effects of housing costs were unimportant in explaining the departure behaviors of the natives and the return behaviors of the non-natives, but became crucial for the departure and onward destination choice behaviors of the non-natives.

For migration of the non-natives, one very important determinant was the ***previous migration distance*** (measured as the distance to native domicile), which had a very strong positive effect on the propensity of making repeat migration, lending support to the disappointment hypothesis (Yezer and Thurston 1976; Grant and Vanderkamp 1986). However, its separate effects on return migration and onward migration were quite different: a U-shaped effect on the return propensity and a monotonically positive effect on the onward propensity, leading to a U-shaped effect on the return/onward ratio. These differential effects

not only supported the disappointment hypothesis, but also revealed the effects of previous migration distance on the depreciation of location-specific capital and on the ability to finance a re-migration. In light of the concave effect of previous migration distance on the return propensity, it is unlikely that previous migration distance will exhibit a significant ***linear effect*** in the return/onward model. This may help explain why findings of previous research on the linear effect of previous migration distance on return migration was inconclusive or insignificant.

The three types of labor migrations in Taiwan were also very subject to ***the market forces***, although return migration was less accountable by the market mechanism than primary and onward migrations. The labor force were relatively sensitive to the employment growth of origin and destination in general, with the sensitivity becoming particularly enhanced for breadwinners and low-skilled workers on the one hand and decreased for women on the other. By contrast, the role of prefectural unemployment level was not important. Its effect was mainly limited to the breadwinners or low-skilled workers. The effects of prefectural income were also very important in explaining labor migrations, with the better educated professional and managerial workers being extremely subject to the income effects. Moreover, the level of similarity between an individual's category of industry (type of economic activities) and a prefecture's employment structure proved crucial to the departure and destination choice behaviors of labor migrations.

The changing regional economic structure as produced by the development of ***economic restructuring and globalization*** (Kuo 1983; Li 1988) was also crucial to account for labor migrations in Taiwan. Regardless of the nativity status, Taipei City as the corporate command center showed (1) that it had a very strong ability to retain the best educated labor

force, but tended to push out the less educated and low-skilled workers, and (2) that it was very capable of attracting the best educated, white-collar professionals and managers from the rest of the country, mostly because of the salient growth in the service sector in the second half of the 1980s. The effect of industrial restructuring was seen in Hsinchu City (Taiwan's Silicon Valley). Regardless of the nativity status, the city not only exhibited a retention effect on the departure propensity of its workforce, but also was very capable of drawing the best-educated migrants (mostly the professional engineers).

8.5 Characteristics and Determinants of Fast Repeat Labor Migrations

Based on the linked micro data of national migration surveys from 1980 through 1989, findings on the determinants of the job-related fast repeat migrations of the labor force are mostly consistent with the findings from North America. The ***major contribution*** of this research is the findings on the effects of previous migration reason, unemployment duration after the previous move, the patriarchal value system, and the budget constraint.

The major findings on the fast repeat migration are summarized as follows. First, the propensity of making fast return migration is negatively affected by the level of education and positively affected by the duration of unemployment, suggesting that those with a ***limited*** labor market knowledge and an ***unsuccessful*** job search are more prone to make a return migration. Second, the propensity of making fast onward migration is strongly enhanced by the number of previous moves and negatively affected by the duration of unemployment, suggesting that more ***experienced*** and more ***successful*** previous migrants are more prone to make an onward migration. Third, those whose reason for the previous migration was job search are more likely to make a fast return migration than those whose reason for the previous migration was job-change/transfer, suggesting that those who have secured a job

at the destination before moving are less likely to be disappointed and to make a fast return migration than those who migrated before securing a job. Fourth, gender selectivity in fast onward migration is very strong in terms of both overall level and age pattern, reflecting the strong dominance of the patriarchal ideology on the Taiwanese society.

The most important factors of fast repeat migrations turned out to be chronicity and patriarchal ideology. Since neither chronicity nor patriarchal ideology can be easily and quickly affected by policies, fast repeat migration may be quite resistant to policy measures, although the findings about the effects of education and unemployment duration suggest that improvement in education and provision of information on job opportunities via such means as the internet can help reduce the level of unnecessary fast repeat migration.

8.6 Contrasts between 1-year and 5-year Repeat Labor Migrations

Findings of the thesis on the behaviors of repeat labor migration based on the linked migration data (1-year period) and population census (5-year period) share some similarity. For example, as opposed to onward migration, return migration was very subject to the effect of location-specific capital left behind and return migrants tended to be those with less human capital, less successful in the market, less sensitive to the market forces. The main reason for this similarity stems from the fact that *the 5-year census had captured part of fast repeat migrations.*

On the other hand, findings based on these two data sources also show some dissimilarity. Being consistent with an earlier finding by Morrison and Da Vanzo (1986) from the PSID data, the thesis found that those who rapidly returned tended to differ distinctly from those who rapidly moved onward and those returnees with longer durations of absence. The most important difference between 1-year and 5-year repeat migrations lies

in the effects of ***information-related factors***: previous migration distance and education.

The difference between the effects of ***previous migration distance*** on 1-year and 5-year repeat migrations is summarized as follows. With respect to 1-year repeat migration, previous migration distance had little effect on return migration but a very strong convex effect on onward migration, leading to a convex effect for repeat migration (Figure 8.1). By contrast, with respect to 5-year repeat migration, it had a moderate concave effect on return migration but a monotonically positive effect on onward migration, resulting in a monotonically positive effect on the propensity of making repeat migration (Figure 8.2). A possible explanation is offered as follows.

Figure 8.1. Effects of Previous Migration Distance on 1-year Return and Onward Migration.

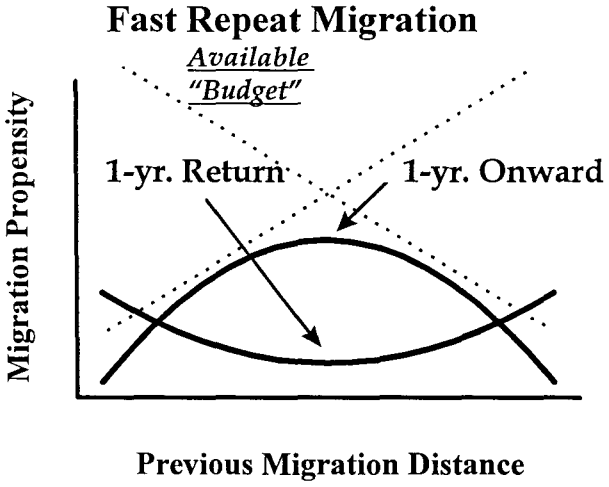
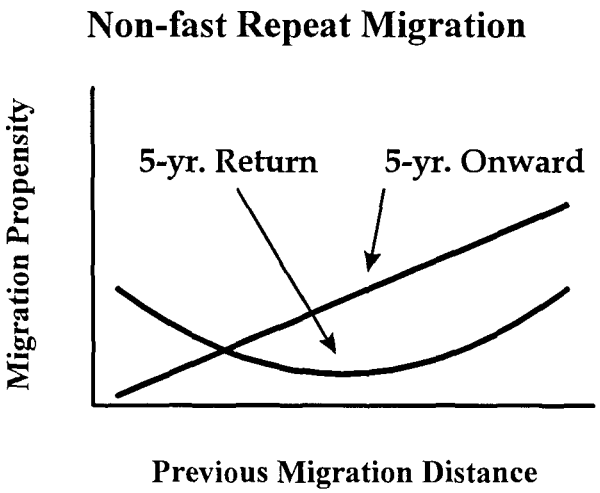


Figure 8.2. Effects of Previous Migration Distance on 5-year Return and Onward Migration.



From the investment-benefit viewpoint, migration benefit is unlikely to materialize immediately right after any investment in migration, particularly when the amount of investment is fairly large. Rather, it is reasonable to expect that the more the amount of migration investment is, the more the time is needed to harvest migration fruits. Although previous migration distance is a good measure of the level of disappointment, it is also a good proxy for the amount of migration investment. According to the hypothesis of ***budget constraint***, a short distance migrant can afford to make fast repeat move, because the migration investment is not so large. However, for a long distance migrant, the need to wait for migration benefit tends to outweigh the consideration of making immediate repeat migration (especially onward migration) when the migrant feels disappointed, leading to the convex effect of previous migration distance (particularly for fast onward migration), as having been revealed by the linked data (see Figure 8.1). But, ***as time passes by***, because a previous long distance migrant might have, for example, (1) become totally disappointed

with previous migration outcome, or (2) gained enough information for making a subsequent move, or (3) earned enough migration benefits from her/his past large migration investment, it is reasonable to expect that previous migration distance tends to be positively associated with the propensity of making repeat migration (either return or onward) in the longer run, as revealed by the census (see Figure 8.2).

As for the difference between the effects of ***educational attainment*** on 1-year and 5-year repeat migrations, education had a very strong negative effect on 1-year return migration but almost no effect on 1-year onward migration, leading to a negative effect for 1-year repeat migration (Figure 8.3). In sharp contrast, education showed a weak negative effect on 5-year return migration but a very strong positive effect on 5-year onward migration, leading to a very strong positive effect on the propensity of 5-year repeat migration (Figure 8.4). This difference can be explained in the following way.

Figure 8.3. Effects of Educational Attainment on 1-year Return and Onward Migration.

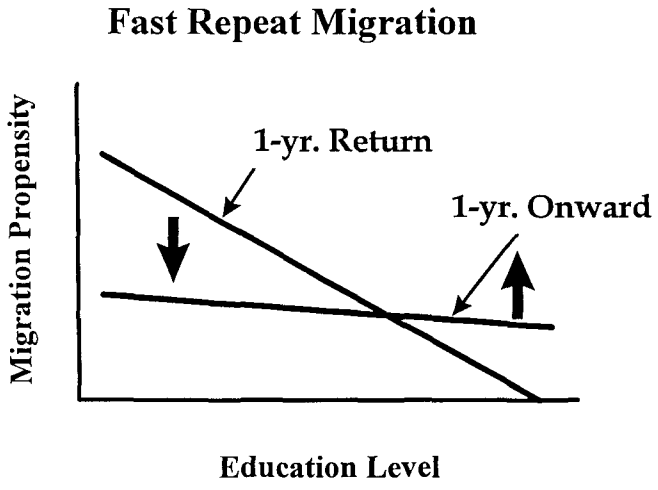
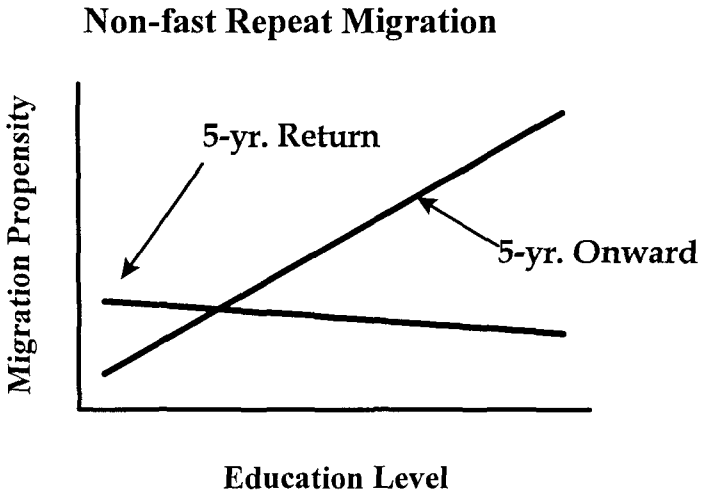


Figure 8.4. Effects of Educational Attainment on 5-year Return and Onward Migration.



The differential effects of educational attainment for 1-year and 5-year repeat migration in my opinion is most likely to be due to the difference in the relative importance of (1) the negative effect of education in making an incorrect migration decision and (2) the positive effect of education in obtaining information of opportunity elsewhere in different time span. The negative educational selectivity for 1-year return migration and the lack of selectivity for 1-year onward migration are mostly due to the differential likelihood of making incorrect migration decision between the less educated and the better educated. Although the better educated migrants are less prone to make fast return or even fast onward migration right after an initial move, it is reasonable to expect that they are more prone to migrate again than the less educated ***in the long run***, because of the differential in the accumulated information of opportunity elsewhere between the better and the less educated. Thus, as time passes by, the educational selectivity for onward migration tends to switch from a pattern with no effect to a pattern with very positive selectivity, whereas the

corresponding pattern for return migration tends to change from a pattern with very negative selectivity to the pattern with very weak negative effect or even no effect, because most of the disappointed less educated who had largely returned can not be captured by the census data.

8.7 Overall Conclusion

The evolution of infrastructural changes and socioeconomic development in Taiwan has been very well documented by previous studies. Much having been ignored in the literature, except for the work like Speare et al (1988), is the links between labor migration and the socioeconomic developments in the spatial context. A substantial contribution of this thesis, benefitted in part from the rich micro migration data of Taiwan, is the enhancement and enrichment of this kind of knowledge.

Population redistribution in Taiwan, as an outcome of the interactions between migrations and socioeconomic changes, was characterized by a northward trend. The underlying triggers lie not only in the internal forces, but also in the external influences of changing global circumstances. With the gradual maturity of Taiwan's infrastructure after World War II, the internal forces played a more important role in reshaping population redistribution.

By decomposing labor flows into primary, return, and onward migrations, the thesis shows that primary and onward migrants were much more responsive to the markets forces than were returnees. However, market forces could not fully explained the behaviors of labor migrants as a result of some strong constraints, like location-specific capital and cultural system. Similar to the experiences of other countries, labor migration had inevitably brought

about some undesirable consequences such as the polarizing distribution of population and pollution. However, it had contributed very much to the establishment of Taiwan's economic base and played a substantial role in promoting the efficiency of market adjustment via the process of relocating the human resources.

Labor migration in Taiwan possesses two very noteworthy features which may help correct some misconceptions of the role of migration. First, in sharp contrast to the experiences of other developing countries (Todaro 1985), labor migration in Taiwan ***has not*** worsened the economic base and social order of rural areas and led to serious urban unemployment. Second, in sharp contrast to other developed countries, labor migration in Taiwan is very ***efficient*** in the sense that the labor force are very responsive to the restructuring of regional economies and market forces. ***In light of the findings on labor migration in Taiwan, it seems that there is no need to formulate any policy measure aiming at regulating flows of labor in general.*** In spite of this, it is recommended that the government establish a set of programs (e.g. those of career retraining and skill upgrading) for the less educated, which may help reduce unnecessary repeat migrations and promote the efficiency of labor market.

8.8 Directions of Future Research

Finally, four potential directions of future research are offered below. The first direction is a suggestion about overcoming some constraints of migration data. The second direction is about methodology. The third and fourth directions are based on the concurrent socioeconomic development trend in Taiwan.

Longitudinal Research The studies of migration have relied largely on the analysis

of the cross-sectional data, either from the sampling surveys or population censuses. However, it is important to note that much of the information of the cross-sectional data sets is recorded after rather than before the incidence of migration, leading to a potential danger of misinterpreting the cause and effect of migration. Thus, more research should be based on longitudinal data, which are undoubtedly more suitable for identifying the causal relationship of migration. However, the most troublesome problem lies largely in the lack of suitable longitudinal data for migration study. With the gradual availability of large-scale official sampling surveys nowadays, a sensible alternative to overcome this constraint is to create a quasi-longitudinal data set by linking together the individual observations in consecutive large-scale surveys, as having been demonstrated in Chapter 7. This alternate has the advantage of being more convenient and much less costly.

Derivation and Verification of the Statistical Distribution of Migration Flows In light of the fact that the macro phenomena of migration outcomes, e.g., in- and out-migration volumes, are simply the aggregate results of individual migration decision-making, it is possible to derive the theoretical asymptotic statistical distributions of the aggregate migration outcomes and to test their theoretical validity by using real-world micro migration data sets. This future research allows us not only to make the point estimation (e.g. the aggregate forecast of in- and out-migration volumes), but also to find the interval estimation (e.g. the 95% confidence interval of in- and out-migration volumes). The resulting margin of uncertainty is expected to be useful for planning purposes.

Impact of Welfare-oriented Policies on Internal Labor Migrations Findings of the thesis have pointed out that labor migrations in Taiwan before the 1990s were very responsive to the varying spatial economic conditions. The Taiwanese case is in sharp

contrast to other developed countries like Canada where migrations were unable to reduce the high national unemployment level and the persistent and large variation in unemployment rates. It is likely that this difference is related to a fact that Taiwan has not yet had a comprehensive unemployment insurance program and very powerful labor unions. As a result of the increasing income level and the growing importance of "check-issuing" election culture (election promises) in Taiwan, the governmental policies have been increasingly pressured to become more welfare-oriented than before. Thus, this evolutionary trend of policy development in Taiwan may provide us with an ideal opportunity to assess the impacts of the implementation of welfare-oriented policy on the efficiency and behavioral characteristics of labor migrations.

Links between Internal and International Labor Migrations In light of the concurrent trend of economic globalization, it is impossible that internal migration can escape the effect of international migration. Since the second half of the 1980s, the trend of globalization and the formation of dual labor market have induced substantial inflows of foreign laborers, either legal or illegal, which have direct or indirect impacts on Taiwan's population and economic system (Selya 1992; Tsay 1992). Thus, one potential area of future research is to explore the impact of international migration on the internal labor flows of Taiwan, particularly the impact on the migration behaviors of low-skilled Taiwanese aborigines and their economic well-beings. Furthermore, in light of the formation of the Asian-Pacific economic system in the past decades, there have been substantial labor and capital flows within this system. With the Taiwanese economy having been deeply integrated into this system, it seems also important to study the links between international migration and in- and outflows of capital in Taiwan.

Appendix 1

Computational Procedures for the Aggregate Predictions of In- and Out-migration Volumes

This appendix describes the computational procedures for carrying out the aggregate predictions of in- and out-migration volumes. Assume a data set has n observations, with the corresponding weight for the i-th observation being represented by W_i. For the i-th observation, let $P_i(o)$ be the probability of the W_i individuals departing from origin o, and $P_i(d|o)$ the conditional probability of the W_i individuals choosing destination d from the choice set D, with o not in D. Note that $P_i(o)$ has a form of binary distribution, the expected value and the variance of which are determined by the personal characteristics of the W_i individuals and the socioeconomic and physical variables of origin o, as well as those of the alternatives in the rest of the system. Similarly, $P_i(d|o)$ has a form of multinominal distribution, the expected value and the variances of which also depend on the personal characteristics of the W_i individuals and the socioeconomic and physical variables of destination d.

The expected number of the W_i individuals departing from origin o is simply equal to $M_i(o) = W_i \times P_i(o)$, and the expected number of the $M_i(o)$ out-migrants choosing destination d is thus equal to $M_i(o,d) = M_i(o) \times P_i(d|o) = W_i \times P_i(o) \times P_i(o|d)$. Therefore, the expected number of out-migrants from origin o, ***OUT(o)***, is simply equal to the sum of $M_i(o)$ over i, and the expected number of in-migrants into destination d, ***IN(d)***, is just the sum of

$M_i(o,d)$ over i and o. Note that since the distribution functions of both $P_i(o)$ and $P_i(d|o)$ belong to the so-called exponential family in theoretical statistics, it can be proved that the aggregate flows like *OUT(o)* and *IN(d)* will have asymptotic normal distributions.

During the research, the author has also derived the theoretical asymptotic expected values and variances of the aggregate quantities, such as the out-migration volume $OUT(g)$, the in-migration volume $IN(g)$, and the net migration volume $IN(g)$ - $OUT(g)$ for a given geographic unit g. Since the emphasis of this thesis is more on substance than on methodology, the proof procedures are not documented in this appendix. In spite of this, the detailed computational procedures for computing the expected values and the corresponding covariance matrix are fully shown in Appendix 2, using Gauss-language as the implementation tool.

Appendix 2

Computational Procedures for the Aggregate Predictions and Asymptotic Distributions of In- and Out-migration Volumes and Rates: Using Gauss-language as an Example

```
0001  /*-----------------------------------------------------------------------------
0002  A. By:
0003       This Gauss program consists of procedures listed below and is designed and
0004     composed by Ji-Ping Lin.
0005
0006  B. Date: March 25th, 1996.
0007
0008  C. Purpose:
0009       It was designed to aggregate the estimated results of the micro-level
0010     discrete choice models (departure and destination choice models) into the
0011     macro-level volumes and rates of in-migration and out-migration and net
0012     migration. Note that this program is particularly suited for impact analysis
0013     by just scaling some variables
0014
0015  D. Document: Not available currently.
0016
0017  E. Notes:
0018     1. For analysis of departure model, call procedure
0019        DepaAnalysis(&GetDepaXFile, DepaDatFile, DepaBetaFile, OutFile, OutTitle),
0020     2. For analysis of both departure and destination choice models, call procedure
0021        DepaDestAnalysis(&GetDepaXFile, &GetDestXFile, DepaDatFile, DepaBetaFile,
0022                         DestDatFile, DestBetaFile, OutFile, OutTitle ),
0023  -----------------------------------------------------------------------------*/
0024  /*** Beginning of main body of program ***/
0025  call InitSystemVar;
0026
0027  /* User-specified file settings */
0028  declare string _ThisPrgName = "DepaDest.gss",
0029  declare string _TmpOutDir   = "\\temp\\";
0030
0031  DepaDatFile  = "dp2529";
0032  DestDatFile  = "dch2529";
0033  DepaBetaFile = "DepaBeta.asc";
0034  DestBetaFile = "DestBeta.asc";
0035
0036  OutFile      = "DepaDest.out";
0037  OutTitle     = "Title of DepaDest out";
0038  call DepaDestAnalysis( &DepaDesiX, &DestDesiX, DepaDatFile, DepaBetaFile,
0039                         DestDatFile, DestBetaFile, OutFile, OutTitle ),
0040  /*** End of main body ***/
0041
0042  /*
0043  This programs includes the following procedures :
0044    proc (0) = InitSystemVar();
0045    proc (0) = DepaDesiX( DepaDatFile,DepaXFile );
0046    proc (0) = DestDesiX( DestDatFile,DestXFile ),
0047    proc (0) = ResetSystem();
0048    proc (1) = DataSetExistence( DataSetName );
0049    proc (0) = InitOutput( OutTextFile, Title );
0050    proc (0) = OutputMat( OutFile, Mat );
0051    proc (0) = ResetOutput();
0052    proc (1) = IndexOfVector( X, IdxValue );
```

```
0053    proc (1) = Category( DatFile, Col );
0054    proc (1) = DepartureProb( X, B );
0055    proc (1) = DestChoiceProb( X, B ),
0056    proc (1) = InclusiveValue( X, B );
0057    proc (2) = BinominalMu_Var( n, p );
0058    proc (1) = FMatToSMat( FMat, Prec );
0059    proc (1) = GetBetaPara( BetaFile );
0060    proc (0) = CheckWrite( WriteToFile );
0061    proc (0) = Check1AggrMacroMig( DepaXFile,DestXFile );
0062    proc (0) = Check2AggrMacroMig( DepaXFile, DepaBetaFile, DestXFile, DestBetaFile );
0063    proc (0) = Check3AggrMacroMig( DepaXFile, DestXFile, TotDestNo );
0064    proc (0) = Check4AggrMacroMig( OrigId, DestVec, DepaObsNo, DestObsNo );
0065    proc (0) = Check5AggrMacroMig( DepaVec, DestVec, DepaObsNo, DestObsNo, TotDestNo );
0066    proc (1) = MigOfDepaDest( OrigId, CateVector, DepaX, DestX );
0067    proc (1) = ProbOfDepaDest( OrigId, CateVector, DepaX, DepaB, DestX, DestB );
0068    proc (1) = ExpecOfDepaDest( OrigId, CateVector, PopAtRisk, ProbVector );
0069    proc (1) = CovOfDepaDest( OrigId, CateVector, PopAtRisk, ProbVector );
0070    proc (0) = AggrMacroMig( DepaXFile, DepaBetaFile, DestXFile, DestBetaFile );
0071    proc (1) = CheckReorga( DepaXFile );
0072    proc (0) = Reorganize( DepaXFile, DestXFile, NewDepaXFile, NewDestXFile );
0073    proc (0) = MacroMig( DepaXFile, DepaBetaFile, DestXFile, DestBetaFile );
0074    proc (0) = Check0MacroDepa( DepaXFile, NoOfBeta );
0075    proc (1) = MacroDepa( DepaXFile, BetaFile ),
0076    proc (0) = DepaReport( MacDepaFile, OutTextFile, Title ),
0077    proc (0) = CheckMacMigFile( MacMigFile );
0078    proc (2) = GetAtRiskPop( CateVector, InRow );
0079    proc (0) = OutputMacMigFile( MacMigFile, OutTextFile, Title );
0080    proc (0) = DepaDestReport( MacMigFile, OutTextFile, Title );
0081    proc (0) = DepaAnalysis( DepaDatFile, DepaBetaFile, OutFile, OutTitle );
0082    proc (0) = DepaDestAnalysis( DepaDatFile, DepaBetaFile, DestDatFile, DestBetaFile, OutFile, OutTitle );
0083  */
0084
0085  /*-------------------------------------------------------------------------*/
0086  /* Tested OK! */
0087  proc (0) = InitSystemVar();
0088  /*
0089  proc InitSystemVar initializes global variables and default settings used in
0090  this program.
0091  */
0092    closeall,
0093
0094    /* Initialize settings regarding output */
0095    declare  _OutputLen = 255;
0096    outwidth _OutputLen;
0097    declare string _LineChar  = "-";
0098
0099    /* Global constant declarations which should not be modified */
0100    declare _False          = 0;
0101    declare _No             = 0;
0102    declare _True           = 1;
0103    declare _Yes            = 1,
0104    declare _NulIntValue    = -9090;
0105    declare _NotFound       = -1;
0106    declare _NotEstablished = -1,
0107
0108    /* Global variable declarations which can be modified by users */
0109    declare _ScreenOn      = 1;
0110    declare _ErrFound      = 0;
0111    declare _PrintErrMsg   = 1;
0112    declare _PrintOn       = 0,
0113    declare _EndProgIfErr  = 1;
0114    declare _ResetTextFile = 0;
0115    declare _PrintPageChar = 1,
0116    declare _PrintDate     = 1;
0117    declare _PrintTime     = 1,
0118    declare _PrintTitle    = 1;
0119    declare _PrintLine     = 1;
0120    declare _PrintNullLine  = 1,
0121    declare _PrintRowTitle = 1;
0122    declare _ClsAtFirst    = 0;
0123    declare _FieldLen      = 8,
0124    declare _DeciLen       = 4;
0125    declare _PrintCovMat   = 0,
0126    declare _ShowProcName  = 0;
0127    declare _ReorganizeData= 0;
0128    declare _CalcCov       = 0,
0129
0130    /* Default temporary file names */
0131    declare string _DepaXTmpName  = "DepaXTmp";
0132    declare string _DestXTmpName  = "DestXTmp";
0133    declare string _MacMigTmpName = "MacDDTmp";
```

```
0134
0135    /* Default settings for DepaXFile */
0136    declare _DepaMiCol    = 1,
0137    declare _DepaPopCol   = 2,
0138    declare _DepaOrigCol  = 3,
0139    declare _DepaX1stCol  = 4,
0140
0141    /*
0142    A boolean value indicating whether the inclusive value is placed in the last
0143    column of the design matrix of departure model.
0144    */
0145    declare _IncInLastCol = 1;
0146
0147    /*
0148    If _IncInLastCol == _No, then _IncCol must be specified by user to indicate
0149    the number of column where inclusive value is palced in the design matrix
0150    of departure model.
0151    */
0152    declare _IncCol = 0;
0153
0154    /* Default settings for DestXFile */
0155    declare _DestMijCol  = 1;
0156    declare _DestOrigCol = 2;
0157    declare _DestDstCol  = 3;
0158    declare _DestX1stCol = 4;
0159
0160    if _ClsAtFirst; cls; endif;
0161    retp;
0162  endp; /* InitSystemVar */
0163  /*-------------------------------------------------------------------------*/
0164  /* Tested OK! */
0165  proc (0) = DepaDesiX( DepaDatFile,DepaXFile );
0166  /*
0167  With DepaDatFile given, GetDepaXFile aims at creating a design martix named
0168  DepaXFile which is in the form of Gauss data set.
0169  */
0170    local InFile;
0171
0172    if _ShowProcName; print "running proc GetDepaXFile  . ", endif,
0173    /* basic checks on DepaDatFile*/
0174    open InFile = ^DepaDatFile;
0175    if InFile == _NotFound,
0176      _ErrFound = _True;
0177      if _PrintErrMsg;
0178        print "proc GetDepaXFile   " $DepaDatFile " not found.",
0179      endif;
0180
0181      if _EndProgIfErr;
0182        print "proc GetDepaXFile stops executing this program due to error(s) found.";
0183        end;
0184      endif;
0185    endif; /* InFile == _NotFound */
0186    InFile = close( InFile );
0187
0188  /*****************************************************************************
0189    Note:
0190      A. The default order of the first three variables in DepaXFile is :
0191           1. MI (the number of outmigrants),
0192           2. POPRISK (the number of population at risk),
0193           3. ORIG (the code of origin)
0194
0195      B. The variables following the above variables are explanaroty variables
0196         whose order must related to the order of Beta parameters of destination
0197         choice model.
0198
0199      C. Given a Gauss data set named DepaDatFile, proc GetDepaXFile is to create
0200         DepaXFile. In this case, variables in the DepaDatFile are as follows .
0201           MI POPRISK CONST INCL LGTAMI AMIGO  LNPOP UNEMP UNEMP85 INCPCR  AFDCR
0202           EMGR NAEMGR  SVEMGR VCRM IMMRUS  IMMRE12 IMMVE12 COLD HOT NNATSH LGTNN
0203           NATSH ARMSH ARMSHP LGTARMP AFDCFSR5 AFDCFSR AFFSGR ORIG AGE SEX RACE
0204           EDUC POVERTY
0205  *****************************************************************************/
0206    dataloop ^DepaDatFile ^DepaXFile,
0207
0208      code POOR   default 0 with 1 for POVERTY == 1;
0209      code FEMALE default 0 with 1 for SEX     == 2;
0210      code WHITE  default 0 with 1 for RACE    == 1;
0211      code BLACK  default 0 with 1 for RACE    == 2;
0212      code ASIAN  default 0 with 1 for RACE    == 3,
0213      code HISP   default 0 with 1 for RACE    == 4;
0214      code INDIAN default 0 with 1 for RACE    == 5,
```

```
0215      code E1     default 0 with 1 for EDUC    == 1;
0216      code E2     default 0 with 1 for EDUC    == 2,
0217
0218      make IMMWT   = IMMRE12 * WHITE,
0219      make IMMBK   = IMMRE12 * BLACK,
0220      make IMMAS   = IMMRE12 * ASIAN,
0221      make IMMHP   = IMMRE12 * HISP,
0222      make IMMIN   = IMMRE12 * INDIAN;
0223      make IMMWT_P = IMMRE12 * WHITE * POOR;
0224      make IMMBK_P = IMMRE12 * BLACK * POOR,
0225      make IMMAS_P = IMMRE12 * ASIAN * POOR,
0226      make IMMHP_P = IMMRE12 * HISP * POOR;
0227      make IMMIN_P = IMMRE12 * INDIAN * POOR,
0228
0229      make LAMIGOWT = LGTAMI * WHITE,
0230      make LAMIGOBK = LGTAMI * BLACK;
0231      make LAMIGOAS = LGTAMI * ASIAN;
0232      make LAMIGOHP = LGTAMI * HISP;
0233      make LAMIGOIN = LGTAMI * INDIAN,
0234
0235      make LAMGE1   = LGTAMI * E1;
0236      make LAMGBKE1 = LGTAMI * BLACK * E1;
0237      make LAMGASE1 = LGTAMI * ASIAN * E1;
0238      make LAMGHPE1 = LGTAMI * HISP * E1;
0239      make LAMGINE1 = LGTAMI * INDIAN *E1,
0240
0241      make UNEMP8E2 = UNEMP85 * E2,
0242
0243      make INCPCE2  = INCPCR * E2;
0244      make INCPCPBK = INCPCR * POOR * BLACK;
0245      make INCPCPHP = INCPCR * POOR * HISP,
0246      make INCPCPIN = INCPCR * POOR * INDIAN,
0247
0248      make EMGRM    = EMGR * (1-FEMALE);
0249
0250      make SVEMGRE1 = SVEMGR *E1;
0251      make SVEMGPBK = SVEMGR *POOR * BLACK;
0252      make SVEMGPAS = SVEMGR *POOR * ASIAN,
0253      make SVEMGPHP = SVEMGR *POOR * HISP;
0254      make SVEMGPIN = SVEMGR *POOR * INDIAN,
0255
0256      make UNEMPE2 = UNEMP85 * E2,
0257
0258      make AFFSF   = AFDCFSR * FEMALE*POOR,
0259      make AFFSFWT = AFFSF * WHITE,
0260      make AFFSFBK = AFFSF * BLACK;
0261      make AFFSFAS = AFFSF * ASIAN;
0262      make AFFSFHP = AFFSF * HISP,
0263      make AFFSFIN = AFFSF * INDIAN,
0264      make AFFSFE1 = AFFSF * E1;
0265
0266      make LNPOPAS = LNPOP * ASIAN,
0267      make LNPOPHP = LNPOP * HISP;
0268
0269      code AS_CAL default 0 with 1 for ASIAN==1 AND ORIG==5,
0270      code HP_BDR default 0 with 1 for HISP==1 AND
0271                                       (ORIG==3 OR ORIG==5 OR ORIG==32 OR ORIG==44);
0272
0273      make ASE1CAL = AS_CAL * E1;
0274      make HPE1BDR = HP_BDR *E1,
0275      make INCLWT  = INCL * WHITE,
0276      make INCLE2  = INCL * E2;
0277      make INCLF   = INCL * FEMALE;
0278
0279      keep MI POPRISK ORIG
0280           CONST NNATSH ARMSHP LAMIGOBK LAMIGOAS LAMIGOHP LAMIGOIN INCPCR INCPCE2
0281           EMGR SVEMGR SVEMGRE1 IMMWT IMMBK IMMIN IMMWT_P IMMBK_P IMMHP_P IMMRUS
0282           AFFSFBK AFFSFHP AFFSFIN COLD HOT LNPOP INCL;
0283    endata; /* end of dataloop ^DepaDatFile ^DepaXFile; */
0284    retp;
0285  endp;
0286  /*-----------------------------------------------------------------------------*/
0287  /* Tested OK' */
0288  proc (0) = DestDesiX( DestDatFile,DestXFile ),
0289  /*
0290  With DestDatFile given, GetDestXFile aims at creating a design martix named
0291  DestXFile which is in the form of Gauss data set
0292  */
0293    local InFile;
0294
0295    if _ShowProcName, print "running proc GetDestXFile  .."; endif;
```

```
0296    /* basic checks on DestDatFile */
0297    open InFile = ^DestDatFile;
0298    if InFile == _NotFound,
0299      _ErrFound = _True,
0300      if _PrintErrMsg;
0301        print "proc GetDestXFile . " $DestDatFile " not found.";
0302      endif,
0303      if _EndProgIfErr;
0304        print "proc GetDestXFile stops executing this program due to error(s) found.";
0305        end;
0306      endif;
0307    endif, /* InFile == _NotFound */
0308    InFile = close( InFile ),
0309
0310  /*
0311    Note.
0312      A. The default order of the first three variables in DestXFile is
0313           1. MIJ  (the number of outmigrants from I to J),
0314           2. ORIG (the code of origin),
0315           3. DST  (the code of destination)
0316
0317      B. The variables following the above variables are explanaroty variables
0318         whose order must related to the order of Beta parameters of destination
0319         choice model.
0320
0321      C. Given a Gauss data set named DestDatFile, proc GetDestXFile is to create
0322         DestXFile. In this case, variables in the DestDatFile are as follows :
0323           MIJ LNDIST CONTG AMIGO LGTAMI LNPOP UNEMP UNEMP85 INCPCR AFDCR EMGR
0324           NAEMGR SVEMGR VCRM IMMRUS IMMRE12 IMMVE12 COLD HOT AFDCFSR5  AFDCFSR
0325           AFFSGR ORIG DST AGE MALE RACE EDUC POVERTY
0326  */
0327    dataloop ^DestDatFile ^DestXFile,
0328
0329      CODE POOR   DEFAULT 0 WITH 1 FOR POVERTY == 1,
0330      CODE WHITE  DEFAULT 0 WITH 1 FOR RACE == 1,
0331      CODE BLACK  DEFAULT 0 WITH 1 FOR RACE == 2,
0332      CODE ASIAN  DEFAULT 0 WITH 1 FOR RACE == 3,
0333      CODE HISP   DEFAULT 0 WITH 1 FOR RACE == 4,
0334      CODE INDIAN DEFAULT 0 WITH 1 FOR RACE == 5;
0335      CODE E1     DEFAULT 0 WITH 1 FOR EDUC == 1;
0336      CODE E2     DEFAULT 0 WITH 1 FOR EDUC == 2,
0337
0338      MAKE AFFSF   = AFDCFSR * (1-MALE)*POOR,
0339      MAKE AFFSFBK = AFFSF * BLACK ;
0340      MAKE AFFSFAS = AFFSF * ASIAN,
0341      MAKE AFFSFHP = AFFSF * HISP,
0342      MAKE AFFSFIN = AFFSF * INDIAN;
0343
0344      MAKE LAMIGOBK = LGTAMI * BLACK;
0345      MAKE LAMIGOAS = LGTAMI * ASIAN,
0346      MAKE LAMIGOHP = LGTAMI * HISP,
0347      MAKE LAMIGOIN = LGTAMI * INDIAN;
0348
0349      MAKE IMRE12E1 = IMMRE12 * E1;
0350
0351      MAKE IMRWT_P = IMMRE12 * WHITE * POOR;
0352      MAKE IMRBK_P = IMMRE12 * BLACK * POOR;
0353      MAKE IMRAS_P = IMMRE12 * ASIAN * POOR;
0354      MAKE IMRHP_P = IMMRE12 * HISP  * POOR;
0355      MAKE IMRIN_P = IMMRE12 * INDIAN* POOR,
0356
0357      MAKE LAMGE1   = LGTAMI * E1;
0358      MAKE LAMGBKE1 = LGTAMI * BLACK * E1;
0359      MAKE LAMGASE1 = LGTAMI * ASIAN * E1;
0360      MAKE LAMGHPE1 = LGTAMI * HISP  * E1;
0361      MAKE LAMGINE1 = LGTAMI * INDIAN* E1,
0362
0363      MAKE DISTE1   = LNDIST * E1,
0364      MAKE INC_E2   = INCPCR * E2;
0365      MAKE SVEMG_E1 = SVEMGR * E1;
0366
0367      KEEP MIJ ORIG DST
0368           LNDIST DISTE1 CONTG LGTAMI LAMIGOBK LAMIGOAS LAMIGOHP LAMIGOIN LAMGE1
0369           LAMGHPE1 INCPCR INC_E2 EMGR SVEMGR SVEMG_E1 IMMRE12 IMRWT_P IMRBK_P
0370           IMRHP_P IMRIN_P AFFSF AFFSFBK AFFSFIN VCRM COLD LNPOP;
0371
0372     endata, /* end of dataloop ^DestDatFile ^DestXFile */
0373     retp;
0374  endp;
0375  /*-------------------------------------------------------------------------*/
0376  /* Tested OK' */
```

```
0377  proc (0) = ResetSystem(),
0378  /*  ResetSystem resets all settings of Gauss into their initial values */
0379    if _ShowProcName; print "running proc ResetSystem .  "; endif,
0380    screen on;
0381    print off;
0382    closeall;
0383    gausset;
0384    print "... End running " _ThisPrgName,
0385    retp;
0386  endp, /* ResetSystem */
0387  /*-----------------------------------------------------------------------------*/
0388  /* Tested OK! */
0389  proc DataSetExistence( DataSetName );
0390  /*
0391  proc DeatSetExistence examines the esistence of DataSetName and returns an boolean
0392  variable named Exist with a value of either _True or _False.
0393  */
0394    local InFile, Exist;
0395    if _ShowProcName; print "running proc DataSetExistence ..."; endif,
0396    Exist = _False;
0397    Open InFile = ^DataSetName;
0398    if InFile /= _NotFound;
0399      Exist = _True;
0400      InFile = close( InFile );
0401    endif,
0402    retp( Exist );
0403  endp; /* DataSetExistence */
0404  /*-----------------------------------------------------------------------------*/
0405  /* Tested OK' */
0406  proc (0) = OutputMat( OutFile, Mat );
0407  /*
0408  proc OutputMat aims at outputing any matrix Mat to an open file handle OutFile
0409  with no retruned values.
0410  */
0411    local OutNo;
0412
0413    if _ShowProcName, print "running proc OutputMat  ..", endif;
0414    _ErrFound = _False;
0415    if colsf( OutFile ) /= cols( Mat );
0416      _ErrFound  = _True,
0417      if _PrintErrMsg,
0418        print "Fatal error found in proc OutputMat .",
0419        print "  The number of columns of output file does not match the number";
0420        print "  of columns of wanted-to-be output matrix.";
0421        print "  col # of OutFile = " colsf( OutFile );
0422        print "  col # of Mat     = " cols( Mat );
0423      endif;
0424      if _EndProgIfErr;
0425        print "proc OutputMat stops executing this program due to error(s) found",
0426        closeall,
0427        end;
0428      endif,
0429    endif; /* colsf( OutFile ) /= cols( Mat ) */
0430
0431    if _ErrFound;
0432      retp;
0433    endif;
0434
0435    /* start outputing Mat to OutFile */
0436    OutNo = writer( OutFile, Mat );
0437    if OutNo /= rows( Mat );
0438      _ErrFound  = _True,
0439      if _PrintErrMsg;
0440        print "Fatal error found in proc OutputMat :";
0441        print "  The number of outputted rows does not match the number";
0442        print "  of rows of wanted-to-be output matrix.",
0443        print "  # of outputted rows = " OutNo;
0444        print "  # of Mat's rows     = " rows( Mat ),
0445      endif,
0446      if _EndProgIfErr,
0447        print "proc OutputMat stops executing this program due to error(s) found",
0448        closeall;
0449        end;
0450      endif;
0451    endif /* OutNo /= rows( Mat ) */;
0452
0453    retp;
0454  endp; /* OutputMat */
0455  /*-----------------------------------------------------------------------------*/
0456  /* Tested OK! */
0457  proc (0) = InitOutput( OutTextFile, Title ),
```

```
0458  /* proc InitOutput initializes somethings for output to OutTextFile  */
0459
0460    if _ShowProcName; print "running proc InitOutput .. "; endif;
0461    if _ResetTextFile;
0462      output file = ^OutTextFile reset,
0463    else;
0464      output file = ^OutTextFile;
0465    endif;
0466    output on;
0467
0468    if not _ScreenOn,
0469      screen off;
0470    endif,
0471
0472    if _PrintTime,
0473      print "TIME : " TimeStr( Time ) ;
0474    endif;
0475
0476    if _PrintDate;
0477      print "DATE   " DateStr( Date ) ,
0478    endif;
0479
0480    if _PrintTime or _PrintDate;
0481      print;
0482    endif,
0483
0484    if _PrintTitle;
0485      if strlen( Title ) /= 0;
0486        print $Title,
0487        if _PrintNulLine, print; endif,
0488      endif;
0489    endif;
0490    retp;
0491  endp; /* InitOutput */
0492  /*-------------------------------------------------------------------------*/
0493  /* Tested OK' */
0494  proc (0) = ResetOutput();
0495  /* proc ResetOutput should be used together with proc InitOutput. */
0496    if _ShowProcName, print "running proc ResetOutput   .", endif;
0497    output off,
0498    if not _ScreenOn,
0499      screen on,
0500    endif,
0501  endp; /* ResetOutput */
0502  /*-------------------------------------------------------------------------*/
0503  /* Tested OK' */
0504  proc IndexOfVector( X, IdxValue ),
0505  /* IndexOfVector aims at determining which element of X IdxValue is   */
0506    local Found, i, Conti;
0507
0508    if _ShowProcName; print "running proc IndexOfVector  . ", endif,
0509    Found = _No,
0510    i = 1;
0511    Conti = (i <= Rows(X)),
0512    do while Conti,
0513      if X[i] == IdxValue,
0514        Found = _Yes;
0515        Conti = _No;
0516      else;
0517        i = i + 1;
0518        Conti = (i <= Rows(X));
0519      endif,
0520    endo; /* do while loop */
0521
0522    if not Found;
0523      i = _NotFound;
0524    endif,
0525
0526    retp( i );
0527  endp; /* IndexOfVector */
0528  /*-------------------------------------------------------------------------*/
0529  /* Tested OK' */
0530  proc Category( DatFile, Col );
0531  /*
0532  Category aims at creating a returned vector named CateVector which contains
0533  sorted distinct categorical values in the Col-th column of DatFile.
0534  */
0535  local X, CateNo, CateVector, CurrentCate, InFile, Conti, Found, i,
0536
0537    if _ShowProcName, print "running proc Category .. ", endif;
0538    open InFile = ^DatFile;
```

```
0539    if InFile == -1;
0540      if _PrintErrMsg;
0541        print "proc Category - file " $DatFile " does not exist.";
0542      endif;
0543      CateVector = _NulIntValue,
0544      Retp( CateVector );
0545    endif;
0546
0547    _ErrFound= _No;
0548    if (Col > Colsf( InFile )) or (Col <= 0);
0549      _ErrFound = _Yes;
0550      if _PrintErrMsg;
0551        print "proc Category : parameter Col falls out of column range of parameter DatFile ",
0552      endif;
0553      CateVector = _NulIntValue;
0554      Retp( CateVector );
0555    endif;
0556    InFile = close( InFile );
0557
0558    CateNo      = 0;
0559    CurrentCate = _NulIntValue;
0560    CateVector  = _NulIntValue;
0561    open InFile = ^DatFile;
0562    do while not eof( InFile );
0563      X = readr( InFile, 1 ),
0564      CurrentCate = X[1,Col];
0565
0566      if CateNo == 0;
0567        CateNo = CateNo + 1,
0568        CateVector[1] = CurrentCate,
0569      else;
0570        i = IndexOfVector( CateVector,CurrentCate );
0571        if i == _NotFound,
0572          CateNo = CateNo + 1;
0573          CateVector = CateVector | CurrentCate,
0574        endif,
0575      endif, /* if CateNo == 0 */
0576    endo, /* while loop */
0577
0578    InFile = close( InFile ),
0579    CateVector = Sortc( CateVector,1 );
0580
0581    retp( CateVector ),
0582  endp; /* Category */
0583  /*-------------------------------------------------------------------------*/
0584  /* Tested OK! */
0585  proc DepartureProb( x,b ),
0586  /*
0587  DepartureProb aims at calculating an individual's probability of departure given
0588  a row vector x and its associated column vector b
0589  */
0590    local Pr;
0591
0592    if _ShowProcName; print "running proc DepartureProb   ."; endif,
0593    _ErrFound = 0,
0594    Pr = 0;
0595    if Cols( x ) == Rows( b ),
0596      Pr = Exp( x*b)/(1 + Exp( x*b ));
0597    else;
0598      _ErrFound = 1,
0599      Pr = _NotEstablished;
0600      if _PrintErrMsg;
0601        print "proc DepartureProb . inconsistent dimensions of input parameters.";
0602      endif;
0603    endif;
0604
0605    retp( Pr );
0606  endp; /* DepartureProb */
0607  /*-------------------------------------------------------------------------*/
0608  /* Tested OK' */
0609  proc DestChoiceProb( X, B );
0610  /*
0611  proc DestChoiceProb calculates probabilities of destination choice given matrix
0612  X and its corresponding parameter B.
0613  */
0614    local DCProb, ExpXB, ExpXBSum,
0615
0616    if _ShowProcName; print "running proc DestChoiceProb ..."; endif,
0617    DCProb = _NotEstablished;
0618    if (cols( X ) /= rows( B )) or (cols(B) /= 1);
0619      if _PrintErrMsg;
```

```
0620        print "proc DestChoiceProb   inconsistent dimensions of X and B.",
0621      endif;
0622      retp( DCProb );
0623    endif;
0624
0625    ExpXB = exp( X*B );
0626    ExpXBSum = sumc( ExpXB );
0627    DCProb = ExpXB / ExpXBSum;
0628    retp( DCProb );
0629  endp; /* DestChoiceProb */
0630  /*-----------------------------------------------------------------------------*/
0631  /* Tested OK! */
0632  proc InclusiveValue( X, B );
0633  /* proc InclusiveValue calculates the inclusive value given X and B. */
0634    local ExpXB, ExpXBSum, IncValue;
0635
0636    if _ShowProcName; print "running proc InclusiveValue  .."; endif;
0637    IncValue = _NotEstablished;
0638    if (cols( X ) /= rows( B )) or (cols(B) /= 1),
0639      if _PrintErrMsg;
0640        print "proc InclusiveValue . inconsistent dimensions of X and B.",
0641      endif;
0642      retp( IncValue ),
0643    endif;
0644
0645    ExpXB = exp( X*B );
0646    ExpXBSum = sumc( ExpXB );
0647    IncValue = ln( ExpXBSum );
0648
0649    retp( IncValue );
0650  endp; /* InclusiveValue */
0651  /*-----------------------------------------------------------------------------*/
0652  /* Tested OK! */
0653  proc (2)=BinominalMu_Var( n,p );
0654  /*
0655  BinominalMu_Var aims at calculating the expected value and variance of a binominal
0656  distribution given X ~ b(n,p).
0657  */
0658    local Mu, Var;
0659
0660    if _ShowProcName, print "running proc BinominalMu_Var  ..."; endif,
0661    _ErrFound = 0;
0662    Mu = 0;
0663    Var = 0;
0664    if (n >= 0) and ((0 <= p) and (p <= 1)),
0665      Mu = n*p;
0666      Var = Mu*(1-p),
0667    else;
0668      _ErrFound = 1;
0669      if _PrintErrMsg,
0670        print "proc BinominalMu_Var: invalid ranges of input parameters n and p ";
0671      endif;
0672    endif;
0673
0674    retp( Mu,Var );
0675  endp; /* BinominalMu_Var */
0676  /*-----------------------------------------------------------------------------*/
0677  /* Tested OK! */
0678  proc FMatToSMat( FMat, Prec ),
0679  /*
0680  proc FMatToSMat transfer a numeric matrix FMat to a string matrix SMat which
0681  will be returned given Leng and Prec.
0682  */
0683    local SMat, i, j;
0684
0685    if _ShowProcName; print "running proc FMatToSMat   ."; endif,
0686    SMat = zeros( rows(FMat),cols(FMat) ),
0687    i = 1,
0688    do while i <= rows( FMat );
0689      j = 1;
0690      do while j <= cols( FMat );
0691        SMat[i,j] = ftos( FMat[i,j],"%*.*lf",1,Prec );
0692        j = j + 1;
0693      endo; /* while j <= cols( FMat ) */
0694      i = i + 1,
0695    endo; /* i <= rows( FMat ) */
0696    retp( SMat );
0697  endp; /* FMatToSMat */
0698  /*-----------------------------------------------------------------------------*/
0699  /* Tested OK! */
0700  proc GetBetaPara( BetaFile ),
```

```
0701  /* GetBetaPara load values in BetaFile into vector Beta[]. */
0702    local Beta,
0703
0704    if _ShowProcName; print "running proc GetBetaPara ..."; endif;
0705    Beta = 0;
0706    load Beta[] = ^BetaFile;
0707
0708    retp( Beta );
0709  endp; /* GetBetaPara */
0710  /*-----------------------------------------------------------------------------*/
0711  /* Tested OK! */
0712  proc (0) = CheckWrite( WriteToFile ),
0713  /* proc CheckWrite checks whether WriteToFile is writeable. */
0714    local OutFile,
0715
0716    if _ShowProcName, print "running proc CheckWrite   ."; endif;
0717    _ErrFound = _False;
0718    create OutFile = ^WriteToFile with Test,1,8,
0719    if OutFile == _NotFound;
0720      _ErrFound = _True,
0721      if _PrintErrMsg;
0722        print "proc CheckWrite : DepaXFile " $WriteToFile " not writeable.",
0723      endif;
0724      if _EndProgIfErr;
0725        print "proc CheckWrite stops executing this program due to error(s) found.";
0726        closeall;
0727        end;
0728      endif;
0729    else;
0730      OutFile = close( OutFile );
0731    endif;
0732
0733    retp,
0734  endp, /* CheckWrite */
0735  /*-----------------------------------------------------------------------------*/
0736  /* Tested OK! */
0737  proc (0) = Check1AggrMacroMig( DepaXFile,DestXFile );
0738  /* proc Check1AggrMacroMig checks the existence of both DepaXFile and DestXFile*/
0739    local Exist;
0740
0741    if _ShowProcName; print "running proc Check1AggrMacroMig ..."; endif,
0742    _ErrFound = _False;
0743    /*  Check the existence of DepaXFile*/
0744    Exist = DataSetExistence( DepaXFile ),
0745    if not Exist;
0746       _ErrFound = _True;
0747       if _PrintErrMsg,
0748         print "proc Check1AggrMacroMig - DepaXFile " $DepaXFile " not found.";
0749       endif,
0750    endif;
0751
0752    /*  Check the existence of DestXFile*/
0753    Exist = DataSetExistence( DestXFile ),
0754    if not Exist;
0755       _ErrFound = _True,
0756       if _PrintErrMsg;
0757         print "proc Check1AggrMacroMig - DestXFile " $DestXFile " not found ";
0758       endif,
0759    endif,
0760
0761    /* if either DepaXFile or DestXFile is not found, then terminate this programs.*/
0762    if _ErrFound;
0763      if _EndProgIfErr;
0764        print "proc Check1AggrMacroMig stops executing this program due to error(s) found",
0765        closeall;
0766        end;
0767      endif,
0768    endif,
0769
0770    retp;
0771  endp; /* Check1AggrMacroMig */
0772  /*-----------------------------------------------------------------------------*/
0773  /* Tested OK! */
0774  proc (0) = Check2AggrMacroMig( DepaXFile, DepaBetaFile, DestXFile, DestBetaFile );
0775  /*
0776  proc Check2AggrMacroMig checks the degree of consistency between the dimensions
0777  of design martix X and parameter vector B
0778  */
0779    local InFile, DepaB, RowsDepaB, DestB, RowsDestB;
0780
0781    if _ShowProcName, print "running proc Check2AggrMacroMig ..."; endif,
```

```
0782    DepaB     = GetBetaPara( DepaBetaFile ),
0783    RowsDepaB = rows( DepaB );
0784    DestB     = GetBetaPara( DestBetaFile ),
0785    RowsDestB = rows( DestB );
0786
0787    /* Check the dimensions of inputed parameters, DepaXFile and DepaBetaFile */
0788    _ErrFound = _False;
0789    Open InFile = ^DepaXFile;
0790    if(colsf(InFile)-_DepaX1stCol+1) < RowsDepaB;
0791      _ErrFound = _True;
0792      if _PrintErrMsg;
0793        print "Fatal error found in proc Check2AggrMacroMig .";
0794        print "  inconsistent dimensions of DepaXFile " $DepaXFile " and DepaBetaFile " $DepaBetaFile;
0795      endif,
0796    endif;
0797    InFile = close( InFile );
0798
0799    /* Check the dimensions of inputed parameters, DestXFile and DestBetaFile */
0800    _ErrFound = _False;
0801    Open InFile = ^DestXFile;
0802    if(colsf(InFile)-_DestX1stCol+1) < RowsDestB,
0803      _ErrFound = _True;
0804      if _PrintErrMsg;
0805        print "Fatal error found in proc Check2AggrMacroMig :";
0806        print "  inconsistent dimensions of DestXFile " $DestXFile " and DestBetaFile " $DestBetaFile;
0807      endif,
0808    endif,
0809    InFile = close( InFile );
0810
0811    /* If inconsistencies are found, then terminate this programs  */
0812    if _ErrFound;
0813      if _EndProgIfErr;
0814        print "proc Check2AggrMacroMig stops executing this program due to error(s) found",
0815        closeall;
0816        end,
0817      endif;
0818    endif, /* _ErrFound */
0819
0820    retp;
0821  endp; /* Check2AggrMacroMig */
0822  /*-----------------------------------------------------------------------------*/
0823  /* Tested OK! */
0824  proc (0) = Check3AggrMacroMig( DepaXFile, DestXFile, TotDestNo );
0825  /*
0826  proc Check3AggrMacroMig checks the numbers of observations in both DepaXFile and
0827  and DestXFile, and retruns both RowsDepaX and RowsDestX.
0828  */
0829    local InFile, RowsDepaX, RowsDestX,
0830
0831    if _ShowProcName; print "running proc Check3AggrMacroMig ...", endif,
0832    _ErrFound = _False,
0833    open InFile = ^DepaXFile;
0834    RowsDepaX = rowsf( InFile ),
0835    InFile = close( InFile );
0836
0837    open InFile = ^DestXFile;
0838    RowsDestX = rowsf( InFile);
0839    InFile = close( InFile );
0840
0841    /* If inconsistencies are found, then terminate this programs. */
0842    if RowsDestX /= (RowsDepaX*(TotDestNo));
0843      _ErrFound = _True;
0844      if _PrintErrMsg;
0845        print "Fatal error found in proc Check3AggrMacroMig :",
0846        print "  the number of observetions in DestXFile " $DestXFile " is not consistent with",
0847        print "  the number of observations in DepaXFile " $DepaXFile " times the number",
0848        print "  of destinations.",
0849      endif;
0850      if _EndProgIfErr;
0851        print "proc Check3AggrMacroMig stops executing this program due to error(s) found";
0852        closeall,
0853        end;
0854      endif;
0855    endif; /* RowsDestX /= (RowsDepaX*(TotDestNo)) */
0856
0857    retp;
0858  endp, /* Check3AggrMacroMig */
0859  /*-----------------------------------------------------------------------------*/
0860  /* Tested OK' */
0861  proc (0) = Check4AggrMacroMig( OrigId, DestVec, DepaObsNo, DestObsNo ),
0862  /*
```

```
0863  proc Check4AggrMacroMig checks whether the column of DestVec storing information
0864  on origin code matches current OrigId  If not, there must be inconsistency between
0865  DepaXFile and DestXFile, and you must reexamine formats of both files.
0866  */
0867    local j,
0868
0869    if _ShowProcName; print "running proc Check4AggrMacroMig    ", endif;
0870    _ErrFound = _False;
0871    j = 1;
0872    do while j <= rows( DestVec );
0873      if DestVec[j,_DestOrigCol] /= OrigId,
0874        _ErrFound = _True,
0875      endif;
0876      j = j + 1;
0877    endo;
0878
0879    if _ErrFound;
0880      if _PrintErrMsg,
0881        print "Fatal error found in proc Check4AggrMacroMig :";
0882        print "  Inconsistency between DepaXFile and DestXFile about the origin";
0883        print "  code. Reexamine formats of both DepaXFile and DestXFile ";
0884        print "  DepaObsNo = " DepaObsNo " , and DestObsNo = " DestObsNo;
0885      endif;
0886      if _EndProgIfErr;
0887        print "proc Check4AggrMacroMig stops executing this program due to error(s) found",
0888        closeall;
0889        end;
0890      endif;
0891    endif; /* _ErrFound */
0892
0893    retp;
0894  endp; /* Check4AggrMacroMig */
0895  /*-----------------------------------------------------------------------------*/
0896  /* Tested OK! */
0897  proc (0) = Check5AggrMacroMig( DepaVec, DestVec, DepaObsNo, DestObsNo, TotDestNo );
0898  /*
0899  proc Check 5AggrMacroMig checks if the number of outmigrants in DepaVec is equal
0900  to the sum of migrants in DestVec. If not, there must be some serious inconsistency
0901  in both formats of DepaXFile and DestXFile.
0902  */
0903
0904    if _ShowProcName; print "running proc Check5AggrMacroMig ...", endif,
0905    _ErrFound = _False;
0906    if DepaVec[1,_DepaMiCol] /= sumc( DestVec[.,_DestMijCol] ),
0907      _ErrFound = _True;
0908      if _PrintErrMsg;
0909        print "Fatal error found in proc Check5AggrMacroMig :",
0910        print "  The number of outmigrants in DepaVec is not equal to the sum of";
0911        print "  migrants in DestVec. Reexamine both DepaXFile and DestXFile.",
0912        print "  row # in DepaXFile = " DepaObsNo,
0913        print "  row # in DestXFile = " DestObsNo "    " DestObsNo+TotDestNo-1,
0914      endif;
0915      if _EndProgIfErr;
0916        print "proc Check5AggrMacroMig stops executing this program due to error(s) found",
0917        closeall;
0918        end,
0919      endif,
0920    endif;
0921
0922    retp;
0923  endp; /* Check5AggrMacroMig */
0924  /*-----------------------------------------------------------------------------*/
0925  /* Tested OK! */
0926  proc MigOfDepaDest( OrigId, CateVector, DepaX, DestX ),
0927  /*
0928  proc MigOfDepaDest calculates the numbers of outmigrants for departure model
0929  and for destination choice model. These numbers are stored in a returned vector
0930  named MigVector.
0931  Note : the IndexOfVector( CateVector,Origid)-th element of MigVector is the
0932         number of outmigrants from OrigId. The other elements of MigVector are
0933         the numbers of migrants to destinations with respect to CateVector.
0934  */
0935    local MigVector, Temp, i, j, DestId;
0936
0937    if _ShowProcName; print "running proc MigOfDepaDest ..."; endif;
0938    _ErrFound  = _False,
0939    MigVector = zeros( rows(CateVector),1 );
0940
0941    /* Put the number of outmigrants of OrigId into MigVector */
0942    i = IndexOfVector( CateVector,OrigId );
0943    MigVector[i,1] = DepaX[1,_DepaMiCol];
```

```
0944
0945    /* Put the number of inmigrants with respect to each destition into MigVector */
0946    j = 1,
0947    do while j <= rows( DestX );
0948      DestId = DestX[j,_DestDstCol ],
0949      if DestId == OrigId;
0950        _ErrFound = _True;
0951        if _PrintErrMsg;
0952          print "Fatal error found in proc MigOfDepaDest  ";
0953          print "  the column storing destination codes including the origin code.",
0954        endif;
0955        if _EndProgIfErr,
0956          print "proc MigOfDepaDest stops executing this program due to error(s) found";
0957          closeall;
0958          end;
0959        endif,
0960      else; /* DestId /= OrigId */
0961        i = IndexOfVector( CateVector,DestId );
0962        MigVector[i,1] = DestX[j,_DestMijCol],
0963      endif;
0964      j = j + 1;
0965    endo; /* while j <= rows( DestX ) */
0966
0967    retp( MigVector ),
0968  endp; /* MigOfDepaDest */
0969  /*-----------------------------------------------------------------------------*/
0970  /* Tested OK! */
0971  proc ProbOfDepaDest( OrigId, CateVector, DepaX, DepaB, DestX, DestB );
0972  /*
0973  proc ProbOfDepaDest calculates both probabilities of departure and destination
0974  choice, and puts them into a returned vector named Prob.
0975  Note: the IndexOfVector( CateVector,OrigId )-th element of Prob is the departure
0976        probability, other elements of Prob are probabilities of destination choice
0977        corresponding to elements of CateVector
0978  */
0979    local RowsDepaB, RowsDestB, DepaXDesi, DestXDesi, Prob, i, j, DestId,
0980          DepaProb, DestProb, IncValue;
0981
0982    if _ShowProcName; print "running proc ProbOfDepaDest    "; endif,
0983    _ErrFound  = _False,
0984
0985    /* calculate destination choice probabilities. */
0986    RowsDestB = rows( DestB );
0987    DestXDesi = DestX[  , _DestX1stCol (_DestX1stCol+RowsDestB-1)],
0988    DestProb  = DestChoiceProb( DestXDesi, DestB );
0989
0990    /* calculate inclusive value */
0991    IncValue = InclusiveValue( DestXDesi, DestB );
0992
0993    /* calculate departure probabilities. */
0994    RowsDepaB = rows( DepaB );
0995    DepaXDesi = DepaX[1 , _DepaX1stCol:(_DepaX1stCol+RowsDepaB-1)],
0996
0997    if _IncInLastCol == _Yes,
0998      DepaXDesi[1, cols(DepaXDesi) ] = IncValue,
0999    else;
1000      if (0 < _IncCol) and (_IncCol <= cols(DepaXDesi)),
1001        DepaXDesi[1, _IncCol] = IncValue;
1002      else;
1003        _ErrFound = _True,
1004        if _PrintErrMsg;
1005          print "Fatal error found in proc ProbOfDepaDest   _IncCol being out of index.",
1006        endif;
1007      endif;
1008    endif;
1009
1010    DepaProb  = DepartureProb( DepaXDesi, DepaB );
1011
1012    if (DepaProb == _NotEstablished) or (IncValue == _NotEstablished) or (DestProb == _NotEstablished);
1013      _ErrFound = _True,
1014      Prob = _NotEstablished;
1015      retp( Prob ),
1016    endif;
1017
1018    /* Put departure probability into Prob vector */
1019    Prob = zeros( rows(CateVector),1 );
1020    i = IndexOfVector( CateVector,OrigId );
1021    Prob[i,1] = DepaProb,
1022
1023    /* Put probabilities of destination choice into Prob Vector */
1024    j = 1;
```

```
1025    do while j <= rows( DestX );
1026      DestId = DestX[j,_DestDstCol ];
1027      if DestId == OrigId;
1028        _ErrFound = _True,
1029        if _PrintErrMsg;
1030          print "Fatal error found in proc ProbOfDepaDest :";
1031          print "  the column storing destination codes including the origin code.",
1032        endif;
1033        if _EndProgIfErr;
1034          print "proc ProbOfDepaDest stops executing this program due to error(s) found";
1035          closeall;
1036          end;
1037        endif;
1038      else; /* DestId /= OrigId */
1039        i = IndexOfVector( CateVector,DestId );
1040        Prob[i,1] = DestProb[j],
1041      endif;
1042      j = j + 1;
1043    endo; /* while j <= rows( DestX ) */
1044
1045    retp( Prob );
1046  endp; /* ProbOfDepaDest */
1047  /*-----------------------------------------------------------------------------*/
1048  /* Tested OK! */
1049  proc ExpecOfDepaDest( OrigId, CateVector, PopAtRisk, ProbVector );
1050  /*
1051  proc ExpecOfDepaDest calculates the expectations of both departure and
1052  destination choice, and puts them into a returned vector named ExpecVector.
1053  Note : the IndexOfVector( CateVector,Origid)-th element of ExpecVector is
1054         the expected number of outmigrants from OrigId. The other elements of
1055         ExpecVector are the expected numbers of migrants to destinations with
1056         respect to CateVector.
1057  */
1058    local ExpecVector, ExpecOfOutMig, i,
1059
1060    if _ShowProcName; print "running proc ExpecOfDepaDest  ..."; endif;
1061    _ErrFound = _False;
1062    i = IndexOfVector( CateVector,OrigId ),
1063
1064    /* Initialize the vector storing the expected numbers of outmigrats and inmigrants */
1065    ExpecVector = ProbVector,
1066    ExpecVector[i,1] = 1,
1067
1068    /* Calculate ExpecVector */
1069    ExpecOfOutMig = ProbVector[i,1]*PopAtRisk, /* ProbVector[i,1] is Pr(OutMig) */
1070    ExpecVector = ExpecOfOutMig*ExpecVector,
1071
1072    retp( ExpecVector ),
1073  endp, /* ExpecOfDepaDest */
1074  /*-----------------------------------------------------------------------------*/
1075  /* Tested OK! */
1076  proc CovOfDepaDest( OrigId, CateVector, PopAtRisk, ProbVector );
1077  /*
1078  proc CovOfDepaDest calculates the covariance matrix of both departure and
1079  destination choice, and puts them into a returned vector named CovVector
1080  */
1081    local CovVector, TotDistNo, OrigNdx, i, j, Temp;
1082
1083    if _ShowProcName; print "running proc CovOfDepaDest ..."; endif;
1084    _ErrFound  = _False,
1085    OrigNdx    = IndexOfVector( CateVector, OrigId );
1086    TotDistNo = rows( CateVector ),
1087    CovVector = zeros( TotDistNo,TotDistNo ),
1088
1089    i = 1;
1090    do while i <= TotDistNo;
1091      j = 1;
1092      do while j <= TotDistNo;
1093        if i == j;
1094          /* for the diagonal element */
1095          if i == OrigNdx;
1096            Temp = ProbVector[OrigNdx,1];
1097            CovVector[i,1] = PopAtRisk*Temp*(1-Temp);
1098          else,
1099            Temp = ProbVector[OrigNdx,1]*ProbVector[i,1],
1100            CovVector[i,1] = PopAtRisk*Temp*(1-Temp);
1101          endif;
1102        else;
1103          if _CalcCov == _Yes,
1104            /* i /= j for the non-diagonal element */
1105            if i == OrigNdx,
```

```
1106              CovVector[OrigNdx,j] = PopAtRisk*(1-ProbVector[OrigNdx,1])*ProbVector[j,1];
1107              CovVector[j,OrigNdx] = CovVector[OrigNdx,j];
1108            else,
1109              Temp = ProbVector[i,1]*ProbVector[j,1];
1110              CovVector[i,j] = - PopAtRisk*ProbVector[OrigNdx,1]^2*Temp,
1111              CovVector[j,i] = CovVector[i,j],
1112            endif;
1113          endif; /* _CalcCov */
1114        endif;
1115        j = j + 1;
1116      endo; /* while j <= TotDistNo */
1117      i = i + 1;
1118    endo; /* while i <= TotDistNo */
1119
1120    retp( CovVector ),
1121  endp; /* CovOfDepaDest */
1122  /*-------------------------------------------------------------------------*/
1123  /* Tested OK! */
1124  proc (0) = AggrMacroMig( DepaXFile, DepaBetaFile, DestXFile, DestBetaFile, MacMigFile );
1125  /*
1126  proc AggrMacroMig is a procedure designed to created a Gauss data set called
1127  MacMigFile whose default name is defined in proc InitSystemVar. Based on inputted
1128  parameters of DepaXFile, DepaBetaFile, DestXFile, and DestBetaFile, AggrMacroMig
1129  creates MacMigFile which thus eables us to analyze inmigration and outmigration
1130  in the macro contexts. To demonstrate the format of MacMigFile, suppose there are
1131  I disjointed areas in DepaXFile, the storage format of variables is described as follows:
1132  (1). The first row of MacMigFile stores the codes of the I areas which are obtained
1133       by analyzing DepaXFile.
1134  (2). After storing the I codes into MacMigFile's first row, later on AggrMacroMig
1135       will store a (3+I)xI matrix to MacMigFile systemmatically for I times with
1136       respect to each area. Therefore, there should be 1+I*((3+I)xI) rows in
1137       MacMigFile.
1138  (3). For each (3+I)xI matrix which records information of a specific area regarding
1139       migration which are described as follows: suppose this specific area are
1140       classified as the i-th area among the I areas
1141       row 1:
1142         the i-th element is this area's total at-risk population, other elements
1143         are set to zero. Thus, this row can give us information on the order of
1144         this area among the I areas.
1145       row 2:
1146         the i-th element is this area's observed number of outmigrants, other
1147         elements are the numbers of these observed outmigrants into other areas.
1148       row 3:
1149         the i-th element is this area's expected number of outmigrants, other
1150         elements are the expected numbers of these expected outmigrants into
1151         other areas.
1152       row 4 ~ I+3:
1153         this square matrix stores information on variances and covariances of
1154         the number of outmigrants and the numbers of these outmigrants to other
1155         areas.
1156  Note : proc AggrMacroMig and proc MacroMig do the same job. Proc AggrMacroMig
1157  is more general than is proc MacroMig in creating MacMigFile  However, proc
1158  MacroMig may be more faster than proc AggrMacroMig. For detailed descriptions
1159  of their differences, see comments in proc MacroMig.
1160  */
1161    local DepaB, DestB, DepaInFile, DestInFile, CateVector, i, j, OutFile,
1162          TotOrigNo, TotDestNo, RowsDepaX, RowsDestX, RowsDepaB, RowsDestB,
1163          DepaObsNo, DestObsNo,  OrigId, DepaObsX, DestObsX, OutNo,
1164          AggrPop, AggrPopVec, PopAtRisk, Migrants, Prob, Expec, Cov, X;
1165
1166    if _ShowProcName; print "running proc AggrMacroMig ..."; endif;
1167    /* Check the existence of both DepaXFile and DestXFile */
1168    call Check1AggrMacroMig( DepaXFile, DestXFile ),
1169
1170    /* Initialize some parameters. */
1171    _ErrFound   = _False;
1172    DepaB       = GetBetaPara( DepaBetaFile );
1173    DestB       = GetBetaPara( DestBetaFile );
1174    RowsDepaB   = rows( DepaB );
1175    RowsDestB   = rows( DestB );
1176    CateVector  = Category( DepaXFile, _DepaOrigCol ),
1177    TotOrigNo   = rows( CateVector );
1178    TotDestNo   = TotOrigNo - 1,
1179
1180    /* Check the feasibility of writing data to MacMigFile */
1181    call CheckWrite( MacMigFile );
1182
1183    /* Checks the dimensions of DepaXFile, DepaBetaFile, DestXFile, and DestBetaFile. */
1184    call Check2AggrMacroMig( DepaXFile, DepaBetaFile, DestXFile, DestBetaFile ),
1185
1186    /* Check the numbers of observations in both DepaXFile and DestXFile */
```

```
1187    call Check3AggrMacroMig( DepaXFile, DestXFile, TotDestNo );
1188
1189    /* Initialize MacMigFile */
1190    if not _ErrFound;
1191      create OutFile = ^MacMigFile with Var, TotOrigNo, 8,
1192      call OutputMat( OutFile, CateVector' );
1193    else,
1194      closeall,
1195      end;
1196    endif;
1197
1198    /* begin the calculations of macro destination choice submodel */
1199    i = 1,  /* "i" is the i-th origin which is the 1-th element of CateVector  */
1200    do while i <= TotOrigNo,
1201      print i,
1202
1203      /* Initialize some parameters in DO WHILE i <= TotOrigNo */
1204      open DepaInFile = ^DepaXFile;
1205      open DestInFile = ^DestXFile,
1206      OrigId    = CateVector[ i ],
1207      RowsDepaX = rowsf( DepaInFile );
1208      RowsDestX = rowsf( DestInFile ),
1209      AggrPop   = 0;
1210      Migrants  = zeros( TotOrigNo,1 ),
1211      Prob      = zeros( TotOrigNo,1 );
1212      Expec     = zeros( TotOrigNo,1 ),
1213      Cov       = zeros( TotOrigNo, TotOrigNo );
1214
1215      DepaObsNo = 0;
1216      do while not eof( DepaInFile );
1217        DepaObsNo = DepaObsNo + 1,
1218        DepaObsX  = readr( DepaInFile,1 ),
1219
1220        /* Check if the origin code of current observation is equal to CateVector(1). */
1221        /* If not, then skip this observation and jump to the top of DO WHILE loop    */
1222        if OrigId /= DepaObsX[ 1,_DepaOrigCol ];
1223          continue;
1224        endif,
1225
1226        DestObsNo = seekr( DestInFile , 1+(DepaObsNo-1)*TotDestNo );
1227        DestObsX  = readr( DestInFile, TotDestNo ),
1228
1229        /* Check whether the origin codes stored in DestObsX are consistent with */
1230        /* OrigId. If not, there must be some serious inconsistency between      */
1231        /* DepaXFile and DestXFile, and you have to reexamine them.              */
1232        call Check4AggrMacroMig( OrigId, DestObsX, DepaObsNo, DestObsNo ),
1233
1234        /* Check if the number of outmigrants in DepaObsX is equal to the sum of  */
1235        /* migrants in DestObsX.                                                  */
1236        call Check5AggrMacroMig( DepaObsX, DestObsX, DepaObsNo, DestObsNo, TotDestNo ),
1237
1238        /* calculate probabilities of departure and destination choice given OrigId. */
1239        PopAtRisk = DepaObsX[ 1,_DepaPopCol ],
1240        AggrPop   = AggrPop + PopAtRisk;
1241        Migrants  = Migrants + MigOfDepaDest( OrigId, CateVector, DepaObsX, DestObsX );
1242        Prob      = ProbOfDepaDest( OrigId, CateVector, DepaObsX, DepaB, DestObsX, DestB );
1243        Expec     = Expec + ExpecOfDepaDest( OrigId, CateVector, PopAtRisk, Prob );
1244        Cov       = Cov + CovOfDepaDest( OrigId, CateVector, PopAtRisk, Prob ),
1245
1246      endo, /* while not eof( DepaInFile ) */
1247
1248      /* Output macro results for a given i to MacMigFile */
1249      AggrPopVec = zeros( TotOrigNo,1 );
1250      AggrPopVec[i,1] = AggrPop;
1251      call OutputMat( OutFile, AggrPopVec' ),
1252      call OutputMat( OutFile, Migrants' );
1253      call OutputMat( OutFile, Expec' );
1254      call OutputMat( OutFile, Cov );
1255
1256      /* Reset the following variables */
1257      DepaInFile = close( DepaInFile );
1258      DestInFile = close( DestInFile );
1259      i = i + 1,
1260     endo; /* while i <= TotOrigNo, */
1261     OutFile = close( OutFile );
1262
1263     retp;
1264    endp; /* AggrMacroMig */
1265    /*-------------------------------------------------------------------------*/
1266    /* Tested OK' */
1267    proc CheckReorga( DepaXFile );
```

```
/*
proc CheckReorga returns a boolean value which indicates whether DepaXFile should
be reorganized by proc Reorganize. For a specific origin code, it checks whether
observations are grouped consecutively. If this is the case for all origin codes,
it returns a _False boolean value, otherwise a _True value, to indicate whether
to call proc Reorganize.
*/
  local ToReorganize, InFile, CateVector, Conti, DepaObsX, PreOrigId,
        OrigId, i, NdxVector, Temp;

  if _ShowProcName; print "running proc CheckReorga .. "; endif;
  /* Initialize returned parameters */
  ToReorganize = _False;
  _ErrFound     = _False,

  /* check for file existence and initialize parameters */
  Open InFile = ^DepaXFile;
  if InFile == _NotFound;
    _ErrFound = _True;
    if _PrintErrMsg;
      print "proc CheckReorga : input parameter DepaXFile " $DepaXFile " not found.";
    endif;
    if _EndProgIfErr,
      print "proc CheckReorga stops executing this program due to error(s) found";
      closeall,
      end,
    endif;
    retp( ToReorganize );
  else;
    InFile = Close( InFile );
    CateVector = Category( DepaXFile, _DepaOrigCol ),
    NdxVector = zeros( rows(CateVector),1 );
  endif;

  /* Begin the main body of proc CheckReorga */
  Open InFile = ^DepaXFile,
  PreOrigId = _NulIntValue;
  Conti = not eof( InFile );
  do while Conti;
    DepaObsX = readr( InFile,1 );
    OrigId = DepaObsX[ 1,_DepaOrigCol ];
    if OrigId == PreOrigId,
      Conti = not eof( InFile );
    else,
      i = IndexOfVector( CateVector,OrigId );
      if NdxVector[i] == 0,
        NdxVector[i] = 1,
        ToReorganize = _False;
        Conti = not eof( InFile );
      else;
        ToReorganize = _True;
        Conti = _False;
      endif,
    endif; /* OrigId /= PreOrigId */
    PreOrigId = OrigId,
  endo, /* do while Conti */
  InFile = close( InFile );

  retp( ToReorganize );
endp; /* CheckReorga */
/*-----------------------------------------------------------------------------*/
/* Tested OK! */
proc (0) = Reorganize( DepaXFile, DestXFile, NewDepaXFile, NewDestXFile ),
  local Temp, CateVector, TotOrigNo, TotDestNo, DepaInFile, DestInFile,
        DepaOutFile, DestOutFile, i, OrigId, DepaObsNo, DestObsNo,DestObsX,
        DepaObsX;
/*
proc Reorganize put all observations with the same origin code in DepaXFile in
a consecutive order. During the process of reorganization, it also reorganizes
observations in DestXFile with respect to observations in DepaXFile. This proc
return on values.
*/

  if _ShowProcName; print "running proc Reorganize . .."; endif,
  /* Check the existence of both DepaXFile and DestXFile */
  call CheckAggrMacroMig( DepaXFile, DestXFile );

  /* Initialize some parameters. */
  _ErrFound   = _False;
  CateVector = Category( DepaXFile, _DepaOrigCol );
  TotOrigNo  = rows( CateVector );
```

```
1349    TotDestNo  = TotOrigNo - 1,
1350
1351    /* Check the numbers of observations in both DepaXFile and DestXFile */
1352    call Check3AggrMacroMig( DepaXFile, DestXFile, TotDestNo );
1353
1354    /* Initialize DepaOutFile and DestOutFile */
1355    if not _ErrFound;
1356      open DepaInFile = ^DepaXFile;
1357      Temp = getname( DepaXFile );
1358      create DepaOutFile = ^NewDepaXFile with ^Temp, 0, typef(DepaInFile);
1359      DepaInFile = close( DepaInFile );
1360
1361      open DestInFile = ^DestXFile;
1362      Temp = getname( DestXFile );
1363      create DestOutFile = ^NewDestXFile with ^Temp, 0, typef(DestInFile),
1364      DepaInFile = close( DestInFile );
1365    else;
1366      _ErrFound = _True;
1367      print "proc Reorganize stops executing this program due to error(s) found",
1368      closeall;
1369      end,
1370    endif;
1371
1372    /* begin reorganizing DepaXFile and DestXFile */
1373    /* "i" is the i-th origin which is the i-th element of CateVector  */
1374    i = 1;
1375    do while i <= TotOrigNo,
1376      /* Initialize some parameters */
1377      open DepaInFile = ^DepaXFile;
1378      open DestInFile = ^DestXFile,
1379      OrigId = CateVector[ i ];
1380
1381      DepaObsNo = 0;
1382      do while not eof( DepaInFile );
1383        DepaObsNo = DepaObsNo + 1;
1384        DepaObsX  = readr( DepaInFile,1 );
1385
1386        /* Check if the origin code of current observation is equal to CateVector(i)  */
1387        /* If not, then skip this observation and jump to the top of DO WHILE loop    */
1388        if OrigId /= DepaObsX[ 1,_DepaOrigCol ];
1389          continue;
1390        endif;
1391
1392        DestObsNo = seekr( DestInFile , 1+(DepaObsNo-1)*TotDestNo );
1393        DestObsX  = readr( DestInFile, TotDestNo ),
1394
1395        /* Check whether the origin codes stored in DestObsX are consistent with */
1396        /* OrigId. If not, there must be some serious inconsistency between      */
1397        /* DepaXFile and DestXFile, and you have to reexamine them               */
1398        call Check4AggrMacroMig( OrigId, DestObsX, DepaObsNo, DestObsNo ),
1399
1400        /* Check if the number of outmigrants in DepaObsX is equal to the sum of  */
1401        /* migrants in DestObsX.                                                  */
1402        call Check5AggrMacroMig( DepaObsX, DestObsX, DepaObsNo, DestObsNo, TotDestNo ),
1403
1404        if not _ErrFound;
1405          call OutputMat( DepaOutFile, DepaObsX ),
1406          call OutputMat( DestOutFile, DestObsX );
1407        endif;
1408      endo; /* while not eof( DepaInFile ) */
1409
1410      /* Reset the following variables */
1411      DepaInFile = close( DepaInFile ),
1412      DestInFile = close( DestInFile );
1413      i = i + 1;
1414    endo; /* while i <= TotOrigNo */
1415    DepaOutFile = close( DepaOutFile ),
1416    DestOutFile = close( DestOutFile );
1417
1418    retp;
1419  endp; /* Reorganize */
1420  /*-----------------------------------------------------------------------------*/
1421  /* Tested OK! */
1422  proc (0) = MacroMig( DepaXFile, DepaBetaFile, DestXFile, DestBetaFile, MacMigFile );
1423  /*
1424  proc MacroMig performs the same job of proc AggrMacroMig. Both procedures create
1425  a Gauss data set named MacMigFile. The differences between them are
1426    (1) that proc MacroMig will check whether DepaXFile and DestXFile should be
1427        reorganized by calling proc CheckReorga, and
1428    (2) that if DepaXFile and DestXFile need to be reorganized, proc MacroMig will
1429        call proc Reorganize to reorganize both DepaXFile and DestXFile
```

```
Therefore, if DepaXFile and DestXFile have both been reorganized in advanced, proc
MacroMig will be much faster than is proc AggrMacroMig in creating MacMigFile
However, if proc MacroMig finds that both DepaXFile and DestXFile should be reorganized
, the relative performance of proc MacroMig to that of proc AggrMacroMig will not
be improved saliently  Besides, proc MacroMig will need more hard drive space to
store two temporary files called NewDepaXFile and NewDestXFile which later on will
replace both DepaXFile and DestXFile in creating MacMigFile. In terms of the storing
format of created MacMigFile, see comments in proc AggrMacroMig.
*/
  local DepaB, DestB, DepaInFile, DestInFile, CateVector, i, j, TotOrigNo,
        TotDestNo, RowsDepaX, RowsDestX, RowsDepaB, RowsDestB, OrigId, OutFile,
        PreOrigId, DepaObsX, DestObsX, OutNo, NewDepaXFile, NewDestXFile,
        AggrPop, AggrPopVec, PopAtRisk, Migrants, Prob, Expec, Cov, X,
        ToReorganize,

  if _ShowProcName, print "running proc MacroMig ..."; endif;
  /* Check the existence of both DepaXFile and DestXFile */
  call Check1AggrMacroMig( DepaXFile, DestXFile ),

  /* Initialize some parameters. */
  _ErrFound  = _False,
  DepaB      = GetBetaPara( DepaBetaFile ),
  DestB      = GetBetaPara( DestBetaFile ),
  RowsDepaB  = rows( DepaB );
  RowsDestB  = rows( DestB );
  CateVector = Category( DepaXFile, _DepaOrigCol ),
  TotOrigNo  = rows( CateVector ),
  TotDestNo  = TotOrigNo - 1;

  /* Check the feasibility of writing data to MacMigFile */
  call CheckWrite( MacMigFile );

  /* Checks the dimensions of DepaXFile, DepaBetaFile, DestXFile, and DestBetaFile. */
  call Check2AggrMacroMig( DepaXFile, DepaBetaFile, DestXFile, DestBetaFile );

  /* Check the numbers of observations in both DepaXFile and DestXFile */
  call Check3AggrMacroMig( DepaXFile, DestXFile, TotDestNo ),

  /* Check whether to reorganize DepaXFile and DestXFile */
  ToReorganize = CheckReorga( DepaXFile ),
  if ToReorganize;
    NewDepaXFile = _TmpOutDir $+ "~" $+ _DepaXTmpName,
    NewDestXFile = _TmpOutDir $+ "~" $+ _DestXTmpName,
    call Reorganize( DepaXFile, DestXFile, NewDepaXFile, NewDestXFile );
    DepaXFile = NewDepaXFile;
    DestXFile = NewDestXFile;
  endif,

  /* Initialize MacMigFile */
  if not _ErrFound,
    create OutFile = ^MacMigFile with Var, TotOrigNo, 8,
    call OutputMat( OutFile, CateVector' );
  else,
    closeall,
    end;
  endif;

  /* begin the calculations of macro destination choice submodel */
  open DepaInFile = ^DepaXFile,
  open DestInFile = ^DestXFile;

  PreOrigId = _NulIntValue;
  do while not eof( DepaInFile );
    DepaObsX  = readr( DepaInFile,1 );
    DestObsX  = readr( DestInFile, TotDestNo ),
    OrigId    = DepaObsX[ 1,_DepaOrigCol ],

    if OrigId /= PreOrigId,
      print OrigId;

      /* Output macro results for a given OrigId to MacMigFile */
      if PreOrigId /= _NulIntValue;
        i = IndexOfVector( CateVector,PreOrigId ),
        AggrPopVec = zeros( TotOrigNo,1 );
        AggrPopVec[i,1] = AggrPop;
        call OutputMat( OutFile, AggrPopVec' );
        call OutputMat( OutFile, Migrants' );
        call OutputMat( OutFile, Expec' ),
        call OutputMat( OutFile, Cov );
      endif; /* PreOrigId /= _NulIntValue */

```

```
1511        /* Initialize needed parameters */
1512        AggrPop    = 0;
1513        Migrants   = zeros( TotOrigNo,1 );
1514        Prob       = zeros( TotOrigNo,1 ),
1515        Expec      = zeros( TotOrigNo,1 );
1516        Cov        = zeros( TotOrigNo, TotOrigNo );
1517      endif, /* OrigId /= PreOrigId */
1518
1519      /* calculate probabilities of departure and destination choice given OrigId. */
1520      PopAtRisk = DepaObsX[ 1,_DepaPopCol ];
1521      AggrPop   = AggrPop + PopAtRisk;
1522      Migrants  = Migrants + MigOfDepaDest( OrigId, CateVector, DepaObsX, DestObsX ),
1523      Prob      = ProbOfDepaDest( OrigId, CateVector, DepaObsX, DepaB, DestObsX, DestB ),
1524      Expec     = Expec + ExpecOfDepaDest( OrigId, CateVector, PopAtRisk, Prob );
1525      Cov       = Cov + CovOfDepaDest( OrigId, CateVector, PopAtRisk, Prob );
1526
1527      PreOrigId = OrigId;
1528    endo; /* while not eof( DepaInFile ) */
1529
1530    /* Output macro results for the last OrigId to MacMigFile */
1531    AggrPopVec = zeros( TotOrigNo,1 );
1532    i = IndexOfVector( CateVector,OrigId );
1533    AggrPopVec[i,1] = AggrPop;
1534    call OutputMat( OutFile, AggrPopVec' );
1535    call OutputMat( OutFile, Migrants' );
1536    call OutputMat( OutFile, Expec' );
1537    call OutputMat( OutFile, Cov );
1538
1539    DepaInFile = close( DepaInFile );
1540    DestInFile = close( DestInFile );
1541    OutFile    = close( OutFile ),
1542
1543    retp;
1544  endp; /* MacroMig */
1545  /*-----------------------------------------------------------------------------*/
1546  /* Tested OK! */
1547  proc (0) = Check0MacroDepa( DepaXFile, NoOfBeta );
1548    local InFile,
1549
1550    if _ShowProcName; print "running proc Check0MacroDepa ..."; endif,
1551    _ErrFound = _False,
1552
1553    /* Open input file and check its existence */
1554    open InFile = ^DepaXFile,
1555    if InFile == _NotFound;
1556      _ErrFound = _True,
1557      if _PrintErrMsg,
1558        print "proc MacroDepa . DepaXFile " $DepaXFile " not found.";
1559      endif;
1560    endif; /* InFile == _NotFound */
1561
1562    /* Check the dimensions of both DepaXFile and DepaBetaFile */
1563    if not _ErrFound; /* when InFile exists */
1564      if ((colsf(InFile)-_DepaX1stCol+1) < NoOfBeta),
1565        _ErrFound = _True,
1566        if _PrintErrMsg;
1567          print "Fatal error found in proc MacroDepa .",
1568          print "  inconsistent dimensions of DepaXFile " $DepaXFile " and DepaBetaFile " $DepaBetaFile,
1569        endif;
1570      endif,
1571      InFile = close( InFile );
1572    endif, /* not _ErrFound */
1573
1574    if _ErrFound,
1575      if _EndProgIfErr;
1576        print "proc MacroDepa stops executing this program due to error(s) found";
1577        closeall;
1578        end;
1579      endif,
1580    endif;
1581
1582    retp;
1583  endp; /* Check0MacroDepa */
1584  /*-----------------------------------------------------------------------------*/
1585  /* Tested OK! */
1586  proc MacroDepa( DepaXFile, DepaBetaFile, MacDepaFile );
1587  /*
1588  proc MacroDepa calculates macro origin-specific means and variances of (1). the
1589  number of outmigrants, and (2). the outmigration rate. These means and varinaces
1590  are stored in a created Gauss data set named MacDepaFile whose storage format is
1591  as follows :
```

```
1592    column  1 : origin-specific code,
1593    column  2 : origin-specific aggregate number of at-risk population,
1594    column  3 . origin-specific observed aggregate number of outmigrants,
1595    column  4 . origin-specific aggregate expected value of the number of outmigrants,
1596    column  5 : origin-specific aggregate variance of the number of outmigrants.
1597  Note : although proc MacroDepa aims at creating MacDepaFile, it also returns DepaMat
1598  */
1599    local DepaMat, ColNoOfDepaMat, Beta, NoOfBeta, InFile, X, OutMig, PopAtRisk,
1600          Orig, Pr, Mu, Var, RowInX, ObsNo, i, TempMat, CateVector, OutFile,
1601
1602    if _ShowProcName, print "running proc MacroDepa .  ", endif;
1603    /* initialization of MacroDepa */
1604    _ErrFound = _False,
1605    DepaMat  = _NotEstablished,
1606    Beta     = GetBetaPara( DepaBetaFile ),
1607    NoOfBeta = rows( Beta ),
1608
1609    /* Basic checks on input parameters before performing proc MacroDepa */
1610    call Check0MacroDepa( DepaXFile, NoOfBeta );
1611
1612    /* initialization of DepaMat */
1613    CateVector = Category( DepaXFile, _DepaOrigCol ),
1614    DepaMat = zeros( rows(CateVector), 5 );
1615    DepaMat[ ,1] = CateVector;
1616
1617    /* main body for creating DepaMat */
1618    ObsNo = 0,
1619    open InFile = ^DepaXFile,
1620    do while not eof( InFile ),
1621      ObsNo = ObsNo + 1;
1622      X = readr( InFile,1 );
1623
1624      OutMig = X[1,_DepaMiCol];
1625      PopAtRisk = X[1,_DepaPopCol],
1626      Orig = X[1,_DepaOrigCol];
1627      X = X[1,_DepaX1stCol.(_DepaX1stCol+NoOfBeta-1)];
1628      Pr = DepartureProb( X,Beta );
1629
1630      if _ErrFound;
1631        if _PrintErrMsg;
1632          print "proc MacroDepa : an error found in calculating departure prob ",
1633          print "                 at observation " ObsNo;
1634        endif;
1635
1636        /* forget calcaulations below and return to the beginning of this loop */
1637        _ErrFound = _False;
1638        continue;
1639      endif, /* _ErrFound */
1640      Mu = PopAtRisk*Pr;
1641      Var = Mu*(1-Pr);
1642
1643      RowInX = IndexOfVector( CateVector,Orig ),
1644      if RowInX /= _NotFound;
1645        DepaMat[RowInX,2] = DepaMat[RowInX,2] + PopAtRisk,
1646        DepaMat[RowInX,3] = DepaMat[RowInX,3] + OutMig,
1647        DepaMat[RowInX,4] = DepaMat[RowInX,4] + Mu,
1648        DepaMat[RowInX,5] = DepaMat[RowInX,5] + Var;
1649      endif,
1650    endo; /* loop of while not eof(InFile) */
1651    InFile = close( InFile );
1652
1653    /* Check the feasibility of writing data to MacDepaFile */
1654    call CheckWrite( MacDepaFile );
1655    if not _ErrFound;
1656      create OutFile = ^MacDepaFile with DepaVar, 5, 8;
1657      call OutputMat( OutFile, DepaMat );
1658      OutFile = close( OutFile ),
1659    endif,
1660
1661    retp( DepaMat ),
1662  endp; /* MacroDepa */
1663  /*-----------------------------------------------------------------------------*/
1664  /* Tested OK! */
1665  proc (0) = DepaReport( MacDepaFile, OutTextFile, Title );
1666  /*
1667  proc DepaReport reports the macro results of departure model to OutTextFile given
1668  a Gauss data set named MacDepaFile which should be created at first by proc MacroDepa
1669  The first five columns of MacDepaFile and DepaMat are as follows:
1670    column  1   origin-specific code,
1671    column  2 : origin-specific aggregate number of at-risk population,
1672    column  3 : origin-specific observed aggregate number of outmigrants,
```

```
1673    column  4 : origin-specific aggregate expected value of the number of outmigrants,
1674    column  5 : origin-specific aggregate variance of the number of outmigrants.
1675  The columns beyond 5 in DepaMatFile are as follows:
1676    column  6 : origin-specific observed aggregate outmigration rate,
1677    column  7 : origin-specific aggregate expected value of outmigration rate,
1678    column  8 : origin-specific aggregate variance of outmigration rate,
1679  */
1680    local Exist, InFile, DepaMat, SumMat, Mask, Fmt, OutResult1, OutResult2;
1681
1682    if _ShowProcName; print "running proc DepaReport .. "; endif;
1683    /* Check the existence of Gauss data set MacDepaFile */
1684    Exist = DataSetExistence( MacDepaFile );
1685    _ErrFound = _False;
1686    if not Exist,
1687      _ErrFound = _True;
1688      if _PrintErrMsg;
1689        print "proc DepaReport . MacDepaFile " $MacDepaFile " not found.";
1690      endif;
1691    endif;
1692
1693    open InFile = ^MacDepaFile;
1694    if colsf( InFile ) /= 5;
1695      _ErrFound = _True;
1696      if _PrintErrMsg;
1697        print "proc DepaReport : the number of columns in MacDepaFile " $MacDepaFile " /= 5.";
1698      endif;
1699      InFile = close( InFile );
1700    else;
1701      DepaMat = readr( InFile, rowsf(InFile) );
1702      InFile = close( InFile ),
1703    endif;
1704    if _ErrFound; retp; endif,              .
1705
1706    /* calculate aggregate values of the whole system */
1707    DepaMat = DepaMat ~ zeros(rows(DepaMat),3),
1708    SumMat  = sumc( DepaMat[. , 2·cols(DepaMat)] ),
1709    SumMat  = "Gross" ~ SumMat';
1710
1711    /* calculate origin-specific expected value and variance of outmigration rate */
1712    DepaMat[ . , 6 ] = DepaMat[ . , 3 ]  / DepaMat[   , 2 ];
1713    DepaMat[ . , 7 ] = DepaMat[ . , 4 ] ./ DepaMat[   , 2 ];
1714    DepaMat[   , 8 ] = DepaMat[ . , 5 ] ./ DepaMat[   , 2 ]^2;
1715    SumMat[ . , 6 ] = SumMat[ . , 3 ] ./ SumMat[ . , 2 ];
1716    SumMat[ . , 7 ] = SumMat[ . , 4 ] ./ SumMat[   , 2 ];
1717    SumMat[ . , 8 ] = SumMat[ . , 5 ] ./ SumMat[   , 2 ]^2;
1718
1719    /* Settings for output */
1720    Mask = ones(1,8),
1721    let Fmt[8,3] =
1722    "*.*lf"  7, 0 /* 1st column format */
1723    "*.*lf" 10, 0 /* 2nd column format */
1724    "*.*lf"  9, 0 /* 3rd column format */
1725    "*.*lf" 13, 4 /* 4th column format */
1726    "*.*lf" 13, 4 /* 5th column format */
1727    "*.*lf"  8, 4 /* 6th column format */
1728    "*.*lf"  8, 4 /* 7th column format */
1729    "*.*le" 12, 4;/* 8th column format */
1730
1731    /* Output the report on macro results of departure model */
1732    call InitOutput( OutTextFile, Title );
1733    print "=============================================================================";
1734    print "    (A)       (B)       (C)       (D)         (E)         (F)      (G)        (H)      ",
1735    print " Origin  Population Observed  Expected    Variance       =        =          =      ",
1736    print "   ID      At Risk    Outmig    Outmig     of Outmig  (C)/(B) (D)/(B)    (E)/(B)^2 ";
1737    print "-----------------------------------------------------------------------------";
1738    OutResult1 = printfm( DepaMat, Mask, Fmt );
1739    print;
1740    Mask[1,1] = 0;
1741    Fmt[1,1] = "* *s";
1742    Fmt[1,2] = 7,
1743    Fmt[1,3] = 7,
1744    OutResult2 = printfm( SumMat, Mask, Fmt ),
1745    print,
1746    print "=============================================================================",
1747    if _PrintPageChar, print chrs(12); endif,
1748    call ResetOutput,
1749
1750    if (OutResult1 /= 1) or (OutResult2 /= 1),
1751      _ErrFound = _True,
1752      print "proc DepaReport   fails to output DepaMat successfully.",
1753    endif;
```

```
1754
1755    retp,
1756  endp; /* DepaReport */
1757  /*-------------------------------------------------------------------------*/
1758  /* Tested OK! */
1759  proc (0) = CheckMacMigFile( MacMigFile );
1760    local Exist, InFile, AreaNo;
1761
1762    if _ShowProcName; print "running proc CheckMacMigFile ..."; endif,
1763    _ErrFound = _False;
1764    /* Check the existence of Gauss data set MacDepaFile */
1765    Exist = DataSetExistence( MacMigFile );
1766    if not Exist;
1767      _ErrFound = _True;
1768      if _PrintErrMsg;
1769        print "proc CheckMacMigFile : MacMigFile " $MacMigFile " not found.",
1770      endif;
1771    endif;
1772
1773    /* Check MacMigFile format */
1774    open InFile = ^MacMigFile;
1775    AreaNo = colsf( InFile );
1776    if (1+(AreaNo+3)*AreaNo) /= rowsf( InFile ),
1777      _ErrFound = _True;
1778      if _PrintErrMsg;
1779        print "proc CheckMacMigFile : (1+(AreaNo+3)*AreaNo) /= rowsf( InFile )";
1780      endif,
1781    endif;
1782    InFile = close( InFile );
1783
1784    retp;
1785  endp; /* CheckMacMigFile */
1786  /*-------------------------------------------------------------------------*/
1787  /* Tested OK! */
1788  proc (2) = GetAtRiskPop( CateVector, InRow ),
1789    local OrigId, AtRiskPop, i, Conti, Found;
1790
1791    if _ShowProcName; print "running proc GetAtRiskPop .. "; endif;
1792    /* Initialize returned parameters */
1793    OrigId    = _NulIntValue;
1794    AtRiskPop = _NulIntValue;
1795
1796    i = 1;
1797    Conti = (i <= cols( InRow ));
1798    Found = _False;
1799    do while Conti;
1800      if InRow[1,i] /= 0,
1801        Found = _True,
1802        Conti = _False,
1803      else;
1804        i = i + 1,
1805        Conti = (i <= cols( InRow ));
1806      endif,
1807    endo; /*  while i <= cols( InRow ) */
1808
1809    if Found;
1810      OrigId = CateVector[i,1],
1811      AtRiskPop = InRow[1,i];
1812    endif,
1813
1814    retp( OrigId, AtRiskPop ),
1815  endp, /* GetAtRiskPop */
1816  /*-------------------------------------------------------------------------*/
1817  /* Tested OK! */
1818  proc (0) = OutputMacMigFile( MacMigFile, OutTextFile, Title ),
1819    local InFile, CateVector, AreaNo, OrigId, AtRiskPop, ObsMig, ExpecMig, CovMig,
1820          VarMig, StrObsMig, StrExpecMig, StrCovMig, StrVarMig;
1821  /*
1822  proc OutputMacMigFile provides a basic function of outputting information on
1823  MacMigFile which is created by proc MacroMig to the text file named OutTextFile,
1824  helping the programer view the contents of MacMigFile
1825  */
1826
1827    if _ShowProcName; print "running proc OutputMacMigFile ...", endif;
1828    /* Basic checks on MacMigFile */
1829    call CheckMacMigFile( MacMigFile );
1830    if _ErrFound,
1831      if _EndProgIfErr;
1832        print "proc OutputMacMigFile stops executing calculations due to error(s) found.";
1833        retp;
1834      endif;
```

```
1835    endif, /* _ErrFound */
1836
1837    /* Main body of OutputMacMigFile */
1838    call InitOutput( OutTextFile, Title );
1839    open InFile = ^MacMigFile;
1840    CateVector = readr( InFile, 1 ),
1841    CateVector = CateVector',
1842    AreaNo = rows( CateVector ),
1843    do while not eof( InFile ),
1844      /* Starting reading data out of InFile and checking their values */
1845      { OrigId,AtRiskPop } = GetAtRiskPop( CateVector, readr( InFile, 1 ) ),
1846      if (OrigId == _NulIntValue) or (AtRiskPop == _NulIntValue);
1847        _ErrFound = _True,
1848        if _PrintErrMsg,
1849          print "proc OutputMacMigFile : error due to (OrigId or AtRiskPop == _NulIntValue)",
1850        endif;
1851        if _EndProgIfErr,
1852          print "proc OutputMacMigFile stops executing this program due to error(s) found",
1853          call ResetOutput;
1854          retp;
1855        endif;
1856      endif; /* (OrigId == _NulIntValue) or (AtRiskPop == _NulIntValue) */
1857      ObsMig   = readr( InFile,1 ),
1858      ExpecMig = readr( InFile,1 ),
1859      CovMig   = readr( InFile, AreaNo );
1860      VarMig   = diag( CovMig )';
1861
1862      /* Start outputting OutputMacMigFile */
1863      format /rdn 1,0,
1864      print "Origin Id : " OrigId;
1865      print "At-risk population : " AtRiskPop,
1866      format /rdn 12,4;
1867      print "Observed outmigrants :",    print ObsMig,
1868      print "Expected outmigrants :",    print ExpecMig,
1869      print "Variance of outmigrants :"; print VarMig,
1870      if _PrintCovMat,
1871        print "Covariance of outmigrants :", print CovMig,
1872      endif,
1873      print,
1874
1875      /*
1876      StrObsMig   = FMatToSMat( ObsMig, 0 );
1877      StrExpecMig = FMatToSMat( ExpecMig, _DecLen ),
1878      StrVarMig   = FMatToSMat( VarMig, _DecLen ),
1879      if _PrintCovMat;
1880        StrCovMig   = FMatToSMat( CovMig, _DecLen ),
1881      endif;
1882      print $StrObsMig,
1883      print $StrExpecMig,
1884      print $StrVarMig;
1885      */
1886    endo; /* while not eof(InFile) */
1887    InFile = close( InFile );
1888    call ResetOutput;
1889
1890    retp;
1891  endp; /* OutputMacMigFile */
1892  /*-----------------------------------------------------------------------------*/
1893  /* Tested OK! */
1894  proc (0) = DepaDestReport( MacMigFile, OutTextFile, Title ),
1895  /*
1896  proc DepaDestReport aims at printing a table regarding outmigration, inmigration,
1897  and netmigration. These results are stored in TempMat whose storage format is as
1898  follows.
1899    Column  1 : area-specific ID,
1900    Column  2 : area-specific at-risk population size,
1901    Column  3 : area-specific observed number of outmigrants,
1902    Column  4 : area-specific expected number of outmigrants,
1903    Column  5   area-specific variance of the number of outmigrants,
1904    Column  6 : area-specific observed number of inmigrants,
1905    Column  7 : area-specific expected number of inmigrants,
1906    Column  8 : area-specific variance of the number of inmigrants,
1907    Column  9 : area-specific observed number of net migration,
1908    Column 10 : area-specific expected number of net migration,
1909    Column 11 : area-specific variance of the number of net migration.
1910  */
1911    local InFile, CateVector, AreaNo, i, j, k, TempMat, TempMat1, OrigId, AtRiskPop, ObsMig,
1912          ExpecMig, CovMig, VarMig, Temp, Mask, Fmt, OutResult1, OutResult2, SumMat, SumMat1;
1913
1914    if _ShowProcName, print "running proc DepaDestReport    ", endif,
1915    /* Basic checks on MacMigFile */
```

```
1916    call CheckMacMigFile( MacMigFile );
1917    if _ErrFound,
1918      if _EndProgIfErr;
1919        print "proc DepaDestReport stops executing calculations due to error(s) found ",
1920        retp,
1921      endif;
1922    endif; /* _ErrFound */
1923
1924    /* Start building TempMat  */
1925    _DeciLen = 1,
1926    open InFile = ^MacMigFile,
1927    CateVector = readr( InFile, 1 );
1928    CateVector = CateVector';
1929    AreaNo = rows( CateVector ),
1930    TempMat = zeros( AreaNo, 11 ),
1931    do while not eof( InFile );
1932      /* Starting reading data out of InFile and checking their values */
1933      { OrigId,AtRiskPop } = GetAtRiskPop( CateVector, readr( InFile, 1 ) );
1934      i = IndexOfVector( CateVector, OrigId ),
1935      ObsMig   = readr( InFile,1 );
1936      ExpecMig = readr( InFile,1 );
1937      CovMig   = readr( InFile, AreaNo );
1938      VarMig   = diag( CovMig )';
1939
1940      /* Initialize area-specific ID */
1941      TempMat[i,1] = OrigId,
1942
1943      /* Initialize information regarding outmigration of i-th area with id=OrigId */
1944      TempMat[i,2] = AtRiskPop;
1945      TempMat[i,3] = ObsMig[1,i];
1946      TempMat[i,4] = ExpecMig[1,i];
1947      TempMat[i,5] = CovMig[i,i];
1948
1949      /* Initialize information regarding inmigration to areas other than the i-th area */
1950      Temp = ObsMig | ExpecMig | VarMig;
1951      j = 1;
1952      do while j <= 3;
1953        /*
1954        if j == 1, then allocate observed outmigrants of the i-th area to other areas.
1955        if j == 2, then allocate expected outmigrants of the i-th area to other areas.
1956        if j == 3, then allocate variance of outmigrants of the i-th area to other areas.
1957        */
1958        k = 1;
1959        do while k <= AreaNo,
1960          if k /= i,
1961            TempMat[k,5+j] = TempMat[k,5+j] + Temp[j,k],
1962          endif,
1963          k = k + 1;
1964        endo; /* while k <= AreaNo */
1965        j = j + 1;
1966      endo; /* while j <= 4 */
1967    endo; /* while not eof(InFile) */
1968    InFile = close( InFile ),
1969    /* Initialize information regarding net migration with respect to each area */
1970    TempMat[., 9] = TempMat[.,6] - TempMat[ ,3];  /* Observed net migration    */
1971    TempMat[.,10] = TempMat[.,7] - TempMat[ ,4];  /* Expected net migration    */
1972    TempMat[.,11] = TempMat[.,5] + TempMat[ ,8];  /* Variance of net migration */
1973    SumMat = sumc( TempMat[. , 2.cols(TempMat)] );
1974    SumMat = "Gross" ~ SumMat',
1975    TempMat1 = TempMat;
1976    SumMat1  = SumMat;
1977
1978    TempMat[ , 5] = sqrt( TempMat[., 5] ); /* Std  err  of outmigration */
1979    TempMat[., 8] = sqrt( TempMat[., 8] ), /* Std. err  of inmigration  */
1980    TempMat[.,11] = sqrt( TempMat[.,11] ), /* Std  err  of netmigration */
1981    SumMat[., 5]  = sqrt( SumMat[., 5] );  /* Std  err  of gross outmigration */
1982    SumMat[., 8]  = sqrt( SumMat[ , 8] ),  /* Std  err. of gross inmigration  */
1983    SumMat[ ,11]  = sqrt( SumMat[ ,11] ),  /* Std  err. of gross netmigration */
1984    /* end of building TempMat  */
1985
1986    /* Start outputting DepaDestReport */
1987    call InitOutput( OutTextFile, Title ),
1988    print
"=============================================================================================================",
1989    print "   (A)       (B)       (C)         (D)       (E)       (F)         (G)       (H)       (I)         (J)       (K)
",
1990    print " Origin    Popu      Obs       Expec    Std Err     Obs       Expec   Std Err    Obs       Expec    Std Err
";
1991    print "   ID     At Risk   Outmig     Outmig   Outmig    Inmig      Inmig    Inmig   Net Mig    Net Mig  Net Mig
";
1992    print
```

```
"-------------------------------------------------------------------------------------------------------------------------",
1993    Mask = ones(1,11),
1994    let Fmt[11,3] =
1995    "*.*lf"  7, 0 /* 1st column format for OrigId          */
1996    "*.*lf" 10, 0 /* 2nd column format for AtRiskPop       */
1997    "*.*lf"  9, 0 /* 3rd column format for ObsOutmig       */
1998    "*.*lf" 11, 0 /* 4th column format for ExpecOutmig     */
1999    "*.*lf"  9, 0 /* 5th column format for VarOfOutmig^0.5 */
2000    "*.*lf"  9, 0 /* 6th column format for ObsInmig        */
2001    "*.*lf" 11, 0 /* 7th column format for ExpecInmig      */
2002    "*.*lf"  9, 0 /* 8th column format for VarOfInmig^0.5  */
2003    "*.*lf"  9, 0 /* 9th column format for ObsNetMig       */
2004    "*.*lf" 11, 0 /*10th column format for ExpecNetMig     */
2005    "*.*lf"  9, 0;/*11th column format for VarOfNetMig^0.5 */
2006    OutResult1 = printfm( TempMat, Mask, Fmt ),
2007    print;
2008
2009    Mask[1,1] = 0;
2010    Fmt[1,1] = "*.*s";
2011    Fmt[1,2] = 7;
2012    Fmt[1,3] = 7;
2013    OutResult2 = printfm( SumMat, Mask, Fmt );
2014    print;
2015    print
"=========================================================================================================================",
2016    if _PrintPageChar; print chrs(12); endif,
2017
2018    TempMat = TempMat1, /* Restore TempMat from TempMat1 */
2019    TempMat[., 3] = 100*TempMat[., 3]    / TempMat[.,2],   /* ObsOutmigRate(%)      */
2020    TempMat[ , 4] = 100*TempMat[., 4]    / TempMat[.,2];   /* ExpecOutmigRate(%)    */
2021    TempMat[., 5] = 100^2*TempMat[., 5] ./ TempMat[.,2]^2; /* VarOfoutmigRate       */
2022    TempMat[., 6] = 100*TempMat[., 6]   ./ TempMat[.,2];   /* ObsInmigRate(%)       */
2023    TempMat[ , 7] = 100*TempMat[., 7]   ./ TempMat[.,2],   /* ExpecInmigRate(%)     */
2024    TempMat[., 8] = 100^2*TempMat[., 8]  / TempMat[.,2]^2; /* VarOfInmigRate        */
2025    TempMat[., 9] = 100*TempMat[., 9]   ./ TempMat[.,2];   /* ObsNetMigRate(%)      */
2026    TempMat[.,10] = 100*TempMat[ ,10]   ./ TempMat[.,2],   /* ExpecNetMigRate(%)    */
2027    TempMat[.,11] = 100^2*TempMat[ ,11]  / TempMat[.,2]^2; /* VarOfNetMigRate       */
2028
2029    SumMat  = SumMat1;  /* Restore SumMat from SumMat1   */
2030    SumMat[., 3]  = 100*SumMat[., 3]    ./ SumMat[ ,2],    /* Gross ObsOutmigRate(%)   */
2031    SumMat[., 4]  = 100*SumMat[., 4]    ./ SumMat[.,2],    /* Gross ExpecOutmigRate(%) */
2032    SumMat[., 5]  = 100^2*SumMat[., 5]  ./ SumMat[ ,2]^2,  /* Gross VarOfoutmigRate    */
2033    SumMat[., 6]  = 100*SumMat[., 6]    ./ SumMat[.,2],    /* Gross ObsInmigRate(%)    */
2034    SumMat[., 7]  = 100*SumMat[., 7]     / SumMat[.,2],    /* Gross ExpecInmigRate(%)  */
2035    SumMat[., 8]  = 100^2*SumMat[., 8]  ./ SumMat[.,2]^2,  /* Gross VarOfInmigRate     */
2036    SumMat[., 9]  = 100*SumMat[., 9]     / SumMat[.,2],    /* Gross ObsNetMigRate(%)   */
2037    SumMat[ ,10]  = 100*SumMat[.,10]    ./ SumMat[.,2];    /* Gross ExpecNetMigRate(%) */
2038    SumMat[.,11]  = 100^2*SumMat[.,11]  ./ SumMat[.,2]^2;  /* Gross VarOfNetMigRate    */
2039
2040    /* Transfer variances to standard errors  */
2041    TempMat[., 5] = sqrt( TempMat[ , 5] ), /* Std. err  of outmigration */
2042    TempMat[., 8] = sqrt( TempMat[., 8] ), /* Std. err  of inmigration  */
2043    TempMat[.,11] = sqrt( TempMat[.,11] ), /* Std. err. of netmigration */
2044    SumMat[.,  5] = sqrt( SumMat[., 5] );  /* Std. err. of gross outmigration rate */
2045    SumMat[.,  8] = sqrt( SumMat[., 8] );  /* Std. err. of gross inmigration rate  */
2046    SumMat[., 11] = sqrt( SumMat[.,11] );  /* Std. err. of gross netmigration rate */
2047
2048    Mask = ones(1,11),
2049    let Fmt[11,3] =
2050    "*.*lf"  7, 0 /* 1st column format for OrigId      */
2051    "*.*lf" 10, 0 /* 2nd column format for AtRiskPop   */
2052    "*.*lf"  9, 0 /* 3rd column format for ObsOutmig   */
2053    "*.*lf"  9, 0 /* 4th column format for ExpecOutmig */
2054    "*.*le" 10, 0 /* 5th column format for VarOfOutmig */
2055    "* *lf"  9, 0 /* 6th column format for ObsInmig    */
2056    "*.*lf"  9, 0 /* 7th column format for ExpecInmig  */
2057    "* *le" 10, 0 /* 8th column format for VarOfInmig  */
2058    "*.*lf"  9, 0 /* 9th column format for ObsNetMig   */
2059    "*.*lf"  9, 0 /*10th column format for ExpecNetMig */
2060    "*.*le" 10, 0,/*11th column format for VarOfNetMig */
2061    Fmt[1, 3] = 0,
2062    i = 3;
2063    do while i <= rows( Fmt );
2064      Fmt[ i,3] = _DecimLen;
2065      i = i + 1;
2066    endo;
2067
2068    print"( continued )",
2069    print "=========================================================================================================";
2070    print "    (A)       (B)       Obs      Expec     Std Err     Obs      Expec     Std Err     Obs      Expec     Std Err ";
2071    print " Origin     Popu     Outmig    Outmig    Outmig     Inmig     Inmig      Inmig    Net Mig  Net Mig   Net Mig ",
```

```
2072    print "   ID     At Risk  Rate(%)  Rate(%)   Rate(%)  Rate(%)  Rate(%)   Rate(%)  Rate(%)  Rate(%)   Rate(%) ",
2073    print "-------------------------------------------------------------------------------------------------------",
2074    OutResult1 = printfm( TempMat, Mask, Fmt ),
2075    print;
2076
2077    Mask[1,1] = 0;
2078    Fmt[1,1] = "*.*s";
2079    Fmt[1,2] = 7;
2080    Fmt[1,3] = 7;
2081    OutResult2 = printfm( SumMat, Mask, Fmt ),
2082    print,
2083    print "=======================================================================================================";
2084    if _PrintPageChar; print chrs(12); endif;
2085    call ResetOutput,
2086    /* End of outputting DepaDestReport */
2087
2088    retp;
2089  endp; /* DepaDestReport */
2090  /*-------------------------------------------------------------------------*/
2091  /* Tested OK! */
2092  proc (0) = DepaAnalysis( &GetDepaXFile, DepaDatFile, DepaBetaFile, OutFile, OutTitle ),
2093    local GetDepaXFile:proc, DepaXFile, MacDepaFile;
2094
2095    /* The following boolean settings which could be modified by users could
2096       be either _Yes or _No. */
2097    _ScreenOn      = _Yes;
2098    _PrintErrMsg   = _Yes;
2099    _EndProgIfErr  = _Yes,
2100    _PrintDate     = _Yes,
2101    _PrintTime     = _Yes;
2102    _PrintPageChar = _Yes,
2103    _ResetTextFile = _No,
2104
2105    /* System-specified settings for temporary output files */
2106    DepaXFile    = _TmpOutDir $+ _DepaXTmpName,
2107    MacDepaFile  = _TmpOutDir $+ _MacMigTmpName;
2108
2109    call GetDepaXFile( DepaDatFile, DepaXFile );
2110    call MacroDepa( DepaXFile, DepaBetaFile, MacDepaFile );
2111    call DepaReport( MacDepaFile, OutFile, OutTitle ),
2112
2113    call ResetSystem;
2114    retp,
2115  endp; /* DepaAnalysis */
2116  /*-------------------------------------------------------------------------*/
2117  proc (0) = DepaDestAnalysis( &GetDepaXFile, &GetDestXFile,
2118                               DepaDatFile, DepaBetaFile,
2119                               DestDatFile, DestBetaFile,
2120                               OutFile, OutTitle ),
2121    local GetDepaXFile:proc, GetDestXFile:proc, DepaXFile, DestXFile, MacMigFile,
2122
2123    /* The following boolean settings which could be modified by users could
2124       be either _Yes or _No  */
2125    _ScreenOn      = _Yes;
2126    _PrintErrMsg   = _Yes;
2127    _EndProgIfErr  = _Yes,
2128    _PrintDate     = _Yes;
2129    _PrintTime     = _Yes;
2130    _PrintPageChar = _Yes;
2131    _ResetTextFile = _No;
2132    _PrintCovMat   = _No;
2133
2134    /* System-specified settings for temporary output files */
2135    DepaXFile  = _TmpOutDir $+ _DepaXTmpName,
2136    DestXFile  = _TmpOutDir $+ _DestXTmpName;
2137    MacMigFile = _TmpOutDir $+ _MacMigTmpName;
2138
2139    /*
2140    Create Gauss data sets DepaXFile and DestXFile out of source Gauss data sets
2141    DepaDatFile and DestDatFile, respectively.
2142    */
2143    call GetDepaXFile( DepaDatFile, DepaXFile ),
2144    call GetDestXFile( DestDatFile, DestXFile );
2145
2146    /* Start calculating macro results for departure and destination choice models. */
2147    if _ReorganizeData;
2148      call MacroMig( DepaXFile, DepaBetaFile, DestXFile, DestBetaFile, MacMigFile );
2149    else; /* default */
2150      call AggrMacroMig( DepaXFile, DepaBetaFile, DestXFile, DestBetaFile, MacMigFile ),
2151    endif;
2152
```

```
2153    /* Generate report ASCII file OutFile. */
2154    call DepaDestReport( MacMigFile, OutFile, OutTitle );
2155
2156    call ResetSystem;
2157    retp;
2158  endp; /* DepaDestAnalysis */
2159  /*-------------------------------------------------------------------------*/
```

Bibliography

Allen, J. 1979. "Information and Subsequent Migration: Further Analysis and Additional Evidence." Southern Economic Journal, 45:1274-1284.

Amery, H.A. and W.P. Anderson. 1995. "International Migration and Remittances to Lebanese Village." The Canadian Geographer, 39:46-58.

Anderson, W.P. and Y.Y. Papageorgiou. 1994. "An Analysis of Migration Streams for the Canadian Regional System, 1952-1983 1. Migration Probabilities." Geographical Analysis, 26(1):15-36.

Barclay, G.W. 1954. Colonial Development and Population in Taiwan. Princeton: Princeton University Press.

Bartik, T.J. 1993. "Who Benefits from Local Job Growth: Migrants or the Original Residents?." Regional Studies, 27(4):297-311.

Bartik, T.J. 1994. "The Effects of Metropolitan Job Growth on the Size Distribution of Family Income." Journal of Regional Science, 34(4):483-501.

Ben-Akiva, M. and S.R. Lerman. 1985. Discrete Choice Analysis: Theory and Application to Travel Demand. Cambridge, MA: MIT Press.

CEPD. 1985-90. The 1985-90 Urban and Regional Development Statistics. Taipei: Council for Economic Planning and Development.

Chang, M.C. 1979. "Migration Selectivity in Taiwan." Journal of Population Studies, 3:43-68, Taipei: Population Studies Center, National Taiwan University.

Chen, C. 1988. "Migration and Transformation of Industrial and Occupational Structures in Taiwan." Journal of Population Studies, 12:121-153, Taipei: Population Studies Center, National Taiwan University.

Chen, C. 1992. "Extended Commuting and Migration in the Taipei Metropolitan Area."

Journal of Population Studies, 15:161-183, Taipei: Population Studies Center, National Taiwan University.

Chen, C. and A. Jr. Speare. 1988. "Migration Differentials in Educational Attainment: the Case of Taiwan," paper presented at the Annual Meeting of the PAA in New Orleans, April 21-23, 1988.

Chen, C.H. 1980. Industrialization of Taiwan during the Japanese Administration. Taipei: Lieng-ching Publishing Ltd (in traditional Chinese)

Chen, C.S. 1959. A Geography of Taiwan. Volume 1. Taipei: Fu-min Geographical Institute of Economic Development. (in traditional Chinese)

Chen, S.H. 1979. Population and Societal Transitions in Taiwan. Taipei: Lieng-ching Publishing Ltd.(in traditional Chinese)

Clark, C. 1989. Taiwan's Development: Implications for Contending Political Economy Paradigms. Westport, Connecticut: Greenwood Press Inc.

Copper,J.F. 1988. A Quiet Revolution: Political Development in the Republic of China. Washington, D.C.: Ethics and Public Policy Center.

Courchene, T.J. 1970. "Inter-provincial Migration and Economic Adjustment." Canadian Journal of Economics, 3(November):550-576.

Courchene, T.J. 1994. Social Canada in the Millennium. Ottawa: C. D. Howe Institute.

DGBAS(Directorate-General of Budget, Accounting, and Statistics). 1981-90. Reports on the 1980-79 Surveys of Internal Migration in Taiwan. Taipei: Census Bureau, DGBAS.

DGBAS. 1986-91a. The 1985-90 Yearbooks of Manpower Survey in Taiwan. Taipei: Census Bureau, DGBAS.

DGBAS. 1986-91b. The 1985-90 Reports on Individual Income Survey. Taipei: Statistic Bureau, DGBAS.

DGBAS. 1991. The 1991 Standard Classification of Industry. Taipei: Statistic Bureau, DGBAS.

DGBAS. 1992. The 1992 Standard Classification of Occupation. Taipei: Statistic Bureau, DGBAS.

DGBAS. 1993a. Reports on the 1991 Industrial and Commercial Census, Volume I. Taipei: Census Bureau, DGBAS.

DGBAS. 1993b. Standard Statistical Area Classifications of Taiwan. Taipei: Statistic Bureau, DGBAS.

DGBAS. 1994. Reports on the 1992 Survey of Internal Migration in Taiwan. Taipei: Census Bureau, DGBAS.

DGBAS. 1994. Reports on the 1994 National Income of Taiwan, ROC. Taipei: Statistic Bureau, DGBAS.

DGBAS. 1996. Reports on the 1996 National Income of Taiwan, ROC. Taipei: Statistic Bureau, DGBAS.

Da Vanzo, J.S. 1976. "Differences between Return and Nonreturn Migration: An Economic Analysis." International Migration Review, 10(1):13-27.

Da Vanzo, J.S. 1978. "Does Unemployment Affect Migration? Evidence from Micro Data." Review of Economics and Statistics, 60(4):504-514.

Da Vanzo, J.S. 1981. "Repeat Migration, Information Costs, and Location-specific Capital." Population and Environment, 4(1):45-73.

Da Vanzo, J.S. 1983. "Repeat Migration in the United States: Who Moves Back and Who Moves On?." Review of Economics and Statistics, 65(4):552-559.

Da Vanzo, J.S. and P.A. Morrison. 1981. "Return and Other Sequences of Migration in the United States." Demography, 18(1):85-101.

Frey, W.H. and K.L. Liaw. 1998. "The Impact of Recent Immigration on Population Redistribution in the United States." in Smith, J.P. and Edmonston, B. (eds) The Immigration Debate. Washington, D. C.: National Academy Press.

Galenson, W.(eds.). 1979. Economic Growth and Structural Change in Taiwan. Cornell University Press.

Gold,T.B. 1986. State and Society in the Taiwan Miracle. New York: M.E.Sharpe Inc.

Goldstein S. 1958. Patterns of Mobility, 1910-1950: The Norristown Study. Philadelphia: University of Pennsylvania Press.

Goss, E. and C. Paul. 1990. "The Impact of Unemployment Insurance Benefits on the Probability of Migration of the Unemployed." Journal of Regional Science, 30(3):349-358.

Grant, E.K. and J. Vanderkamp. 1984. "A Descriptive Analysis of the Incidence and Nature of Repeat Migration within Canada, 1968-71." Canadian Studies in Population, 11(1):61-78.

Grant, E.K. and J. Vanderkamp. 1985. "Migrant Information and the Remigration Decision: Further Evidence." Southern Economic Journal, 51:1202-1215.

Grant, E.K. and J. Vanderkamp. 1986. "Repeat Migration and Disappointment." Canadian Journal of Regional Science, 9:299-322.

Greenwood, M.J. 1975. "Research on Internal Migration in the United States: A Survey." The Journal of Economic Literature, 13(2):397-433.

Greenwood, M.J., G.L. Hunt and J.M. McDowell. 1986. "Migration and Employment Change: Empirical Evidence on the Spatial and Temporal Dimensions of the Linkage." Journal of Regional Science, 26(2):223-234.

Haurin, D.R. and R.J. Haurin. 1988. "Net Migration, Unemployment, and the Business Cycle." Journal of Regional Science, 28(2):239-254.

Herzog, H.W. and A.M. Schlottmann. 1982. "Moving Back vs Moving On: the Concept of Home in the Decision to Remigrate." Journal of Regional Science, 22(1):73-82.

Herzog, H.W. and A.M. Schlottmann. 1983. "Migrant Information, Job Search and the Remigration Decision." Southern Economic Journal, 50:43-56.

Herzog, H.W. and A.M. Schlottmann. 1984. "Labor Force Mobility in the United States: Migration, Unemployment, and Remigration." International Regional Science Review, 9:43-58.

Hicks, J. 1932. The Theory of Wages. London: Macmillan.

Hsiung, P.C. 1996. Living Rooms as Factories: Class, Gender, and Satellite Factory System in Taiwan. Philadelphia: Temple University Press.

Hsu,M. 1980. The Four-hundred-year History of the Taiwanese. San Jose, California: Paradise Culture Associates.

Ishida, H. 1988. "The Conditions of Industrialization, Chapter 3, section 1 (pp.43-75)" in Taiwan's Industrialization: The Formation of the Base of International Manufacturing. Tokyo: The Institute of Developing Economies. (in Japanese)

Kanaroglou, P., K.L. Liaw, and Y.Y. Papageorgiou. 1986. "An analysis of Migratory System: 2.Operational Framework." Environment and Planning A, 18:1039-1060.

Kau, J.B. and C.F. Sirmans. 1977. "The Influence of Information Cost and Uncertainty on Migration: A Comparison of Migrant Types." Journal of Regional Science, 17(1):89-96.

Kerr, G.H. 1965. Formosa Betrayed. Boston: Houghton-Mifflin.

Kuo, S.W.Y. 1983. The Taiwan Economy in Transition. Boulder, Colorado: Westview Press Inc.

Kuznets, S. 1979. "Economic Growth and Structural Change in Taiwan," in Galenson,W.(eds.) Economic Growth and Structural Change in Taiwan. Cornell University Press.

Kuznets, S. 1979. Growth, Population and Income Distribution. New York: W.W. Norton and Co.

Lansing J.B. and E. Mueller. 1967. The Geographic Mobility of Labor. Ann Arbor: Survey of Research Center, University of Michigan.

Lee, E.S. 1966. "A Theory of Migration." Demography, 3:47-57.

Lee,T.H. 1971.Intersectoral Capital Flows in the Economic Development of Taiwan, 1895-1960. Cornell University Press.

Li, K.T. 1988. Economic Transformation of Taiwan. London: Shepheard-Walwyn Publishers Ltd.

Li, W.L. 1976. "Internal Migration and Regional Development in Taiwan," in Richmond,A.H. and D. Kubat(eds.) Internal Migration: the New World and the Third World. London: SAGE Publications Ltd.

Liao, C.H. 1988. "Urbanization in Taiwan: 1900-1985." Journal of Population Studies, 11:129-162, Taipei: Population Studies Center, National Taiwan University.

Liaw, K.L. 1990. "Joint Effects of Personal Factors and Ecological Variables on the Interprovincial Migration Pattern of Young Adults in Canada." Geographical Analysis, 22:189-208.

Liaw, K.L. 1998. "Human Resources and Economic Development in the Atlantic Region of Canada," in Michio Kimura and Yasuko Hayase (ed) Proceeding of the International Seminar on Human Resources and Regional Development in the APEC Member Economies. Tokyo: Institute of Developing Economies.

Liaw, K.L. and J. Ledent. 1987, "Nested Logit Model and Maximum Quasi-likelihood Method: A Flexible Methodology for Analyzing Interregional Migration Patterns." Regional Science and Urban Economics,17:67-88.

Liaw, K.L. and J. Ledent. 1988. "Joint Effects of Ecological and Personal Factors on Elderly Interprovincial Migration in Canada." Canadian Journal of Regional Science, 11(1):77-100.

Liaw, K.L. and W.H. Frey. 1996. "Interstate Migration of American Young Adults in 1985-90: An Explanation Using a Nested Logit model." Geographical System, 3:301-334.

Liaw, K.L. and Y. Hayase. 1997. "Rural/urban Migrations in Zimbabwe in 1982-92: Selectivity by Gender, Place of birth, and Educational attainment." Journal of Population Studies ,20:3-21. Tokyo.

Liaw, K.L., J.P. Lin and W.H. Frey. 1997. "Impacts of Low-skilled Immigration on the Internal Migration of the US-born Low-skilled Persons in the United States: An Assessment in A Multivariate Context." Hamilton, Ontario: School of Geography and Geology, McMaster University.

Lin, J.P. and K.L. Liaw. 1998, "Primary Migration of Taiwanese Young Labor Force in the

Context of Economic Restructuring and Globalization: An Explanation Based on the 1990 Census." Hamilton, Ontario: School of Geography and Geology, McMaster University.

Lin, J.P., K.L. Liaw and C.L. Tsay. 1997. "Determinants of Fast Repeat Migrations of the Labor Force: Evidence from the Linked National Survey Data of Taiwan." Environment and Planning A, forthcoming

Liu, S. K. 1988. "The Development of Private Enterprises, Chapter 3, section 3 (pp. 152-184)" in Taiwan's Industrialization: The Formation of the Base of International Manufacturing. Tokyo: The Institute of Developing Economies. (in Japanese)

Long, L. 1988. Migration and Residential Mobility in the United States. New York: Russel Sage Foundation.

Lowry, I.S. 1966. Migration and Metropolitan Growth: Two Analytical Models. San Francisco, California: Chandler Publishing Company.

Lucas, R.E.B. and O. Stark. 1985. "Motivations to Remit: Evidence from Botswana." Journal of Political Economy, 93:901-918.

Massey, D.S., et al. 1993. "Theories of International Migration: A Review and Appraisal." Population and Development Review, 19(3):431-466.

Massey, D.S., et al. 1994. "An Evaluation of International Migration Theory: the North American Case." Population and Development Review, 20(4):699-751.

McCullagh, P. 1983. "Quasi-likelihood Functions." The Annals of Statistics, 11:59-67.

McFadden, D. 1974. "Conditional Logit Analysis of Qualitative Choice Behavior," in P. Zarembka(eds) Frontiers in Econometrics, Academic Press, New York.

Miller, A.R. 1977. "Interstate Migrants in the United States: Some Social-economic Differences by Type of Move." Demography, 14(1):1-17.

Miller, E. 1972. "A Note on the Role of Distance in Migration: Costs of Mobility versus Intervening Opportunities." Journal of Regional Science, 12(3):475-478.

Mills, E.S. and B.W. Hamilton. 1989. Urban Economics. Glenview, Illinois: Scot Foreswan and Company.

Ministry of Interior. 1994. The 1993 Taiwan-Fukien Demographic Fact Books. Taipei: Ministry of Interior.

Morrison P A, 1971. "Chronic Movers and the Future Redistribution of Population: A Longitudinal Analysis." Demography, 8(2):171-184.

Morrison, P.A. 1969. Theoretical Issues in the Design of Population Mobility Models. The RAND Corporation, P-4342.

Morrison, P.A., and J.S. Da Vanzo. 1986. "The Prism of Migration: Dissimilarities between Return and Onward Movers." Social Science Quarterly, 67(3):504-516.

Mueller, E. 1977. "The Impact of Demographic Factors on Economic Development in Taiwan." Population and Development Review, 3(½):1-22.

Myrdal, G. 1957. Econometric Theory and Underdeveloped Regions. London: Methuen.

Newbold, K.B. 1996. "Income, Self-selection, and Return and Onward Interprovincial Migration in Canada." Environment and Planning A, 28:1019-1034.

Newbold, K.B. and K.L. Liaw. 1990. "Characterization of Primary, Return, and Onward Interprovincial Migration in Canada: Overall and Age-specific Patterns." Canadian Journal of Regional Science, 13(1):17-34.

Newbold, K.B. and K.L. Liaw. 1994. "Return and Onward Interprovincial Migration through Economic Boom and Bust in Canada, form 1976-81 to 1981-86." Geographical Analysis, 26(3):228-245.

Newbold, K.B. and K.L. Liaw. 1995. "Return and Onward Migration in Canada, 1976-81: An Explanation by Personal and Ecological Attributes." The Canadian Geographer, 39(1):16-30.

Piore, M.J. 1979. Birds of Passage: Migrant Labor in Industrial Societies. Cambridge: Cambridge University Press.

Portes, A. and J. Walton. 1981. Labor, Class, and the International System. New York: Academic Press.

Ranis, G. 1979. "Industrial Development", in Galenson, W.(eds.) Economic Growth and Structural Change in Taiwan. Cornell University Press.

Ranis, G. 1992. "From Developing to Mature Economy: An Overview," in Ranis,G.(eds.) Taiwan: From Developing to Mature Economy. Boulder, Colorado: Westview Press Inc.

Ravenstein, E.G. 1889. "The Laws of Migration." Journal of the Royal Statistical Society, LII:241-301.

Rhoda, R. 1983. "Rural Development and Urban Migration: Can We Keep Them Down on the Farm?." International Migration Review, 17(1):34-64.

Rogers, A. 1979. "Migration Patterns and Population Redistribution." Regional Science and Urban Economics, 9:275-310.

Rogers, A. 1988. "Age Patterns of Elderly Migration: An International Comparison." Demography, 25(3):355-370.

Rogers, A. and A. Belanger. 1990. "The Importance of Place of Birth in Migration and Population Redistribution Analysis." Environment and Planning A, 22:193-210.

Sassen,S. 1988. The Mobility of Labor and Capital: A Study in International Investment and Labor Flow. London: Cambridge University Press.

Schlottmann, A.M. and H.W. Herzog. 1981. "Employment Status and the Decision to Migrate." Review of Economics and Statistics, 63(4):590-598.

Schlottmann, A.M. and H.W. Herzog. 1982. "Home Economic Conditions and the Decision to Migrate: New Evidence for the U.S. Labor Force." Southern Economic Journal, 48(4):950-961.

Schwartz, A. 1973. "Interpreting the Effect of Distance on Migration." Journal of Political Economy, 81:1153-1169.

Scott, M. 1979. "Foreign Trade," in Galenson,W.(eds.) Economic Growth and Structural Change in Taiwan. Cornell University Press.

Selya, R.M. 1974. The Industrialization of Taiwan: Some Geographic Considerations. Jerusalem, Israle: The Jerusalem Academic Press.

Selya, R.M. 1992. "Illegal Migration in Taiwan: a Preliminary Overview." International Migration Review, 26(3):787-805.

Selya, R.M. 1995. Taipei. John Wiley & Sons Ltd.

Sjaastad, L.A. 1962. "The Costs and Returns of Human Migration." Journal of Political Economy: Supplement, 70:80-93.

Speare, A.Jr. 1974. "Urbanization and Migration in Taiwan." Economic Development and Cultural Change, 22(2):302-317.

Speare, A.Jr., P.K.C. Liu, and C.L. Tsay. 1988. Urbanization and Development: the Rural-urban Transition in Taiwan. Boulder, Colorado: Westview Press Inc..

Stark, O. 1991. The Migration of Labor. Cambridge, MA: Blackwell Publishers.

Stark, O., and J.E. Taylor. 1989. "Relative Deprivation and International Migration." Demography, 26:1-14.

Stark, O., and R.E.B. Lucas. 1988. "Migration, Remittances and the Family." Economic Development and Cultural Change, 36:465-481.

Stouffer, S.A. 1940. "Intervening Opportunities: A Theory Relating Mobility and Distance." American Sociological Review, 5:845-867.

Thorbecke, E. 1979. "Agricultural Development," in Galenson,W.(eds.) Economic Growth and Structural Change in Taiwan. Cornell University Press.

Tien, H.M. 1988. "Social Change and Political Development in Taiwan," in Feldman,H.J. et al(eds.) In Search of the Way: Taiwan in a Time of Transition. New York: Professors World Peace Academy.

Todaro, M.P. 1969. "A Model of Labor Migration and Urban Unemployment in Less Developed Countries." The American Economic Review, 59:138-148.

Todaro, M.P. 1985. Urbanization and Migration: Internal and International, in Economic Development in the Third World. New York: longman, 247-284.

Train, K. 1986. Qualitative Choice Analysis: Theory, Econometrics, and an Application to Automobile Demand. Cambridge, MA: MIT Press.

Tsai, H.C. 1978. "Development Policy and Internal Migration in Taiwan." Journal of Population Studies, 2:27-59, Taipei: Population Studies Center, National Taiwan

University.

Tsay, C.L. 1982. "Migration and Population Growth in Taipei Municipality." Taipei: Industry of Free China, 57(3):9-25.

Tsay, C.L. 1987. "Status of Women in Taiwan: Educational Attainment and Labor Force Development, 1951-83." Taipei: Academia Economic Papers, 15(1):153-181.

Tsay, C.L. 1992. "Clandestine Labor Migration in Taiwan." Asian and Pacific Migration Journal, 1(3-4):637-655.

Tsay, C.L. 1993. "Industrial Restructuring and International Competition in Taiwan." Environment and Planning A, 25(1):111-120.

Tsay, C.L. 1994. "Labor Recruitment in Taiwan: a Corporate Strategy in Industrial Restructuring." Environment and Planning A, 26(4):583-607.

Tsay, C.L. 1995. "Taiwan." ASEAN Economic Bulletin (Special Issue on Labour Migration in Asia). 12 (2): 175-190.

Van Dijk,J., H. Folmer, H.W. Herzog, and A.M. Schlottmann. 1989. "Labor Market Institutions and the Efficiency of Interregional Migration: a Cross-nation Comparison," in Van Dijk et al.(Eds) Migration and Labor Market Adjustment, pp. 61-83. Dordrecht: Kluwer Academic.

Vanderkamp, J. 1971. "Migration Flows, Their Determinants and the Effects of Return Migration." Journal of Political Economy, 79:1012-1031.

Vanderkamp, J. 1972. "Return Migration: Its Significance and Behavior." Western Economic Journal, 10:460-465.

Wallerstein, I. 1974. The Modern World System, Capitalist Agriculture and the Origins of the European World Economy in the Sixteenth Century. New York: Academic Press.

Wilson, A.G. 1970. Entropy in Urban and Regional Modelling. London: Pion.

Wu, T.S. and H.C. Tsai. 1977. "Patterns of Agricultural Emigration and Multiple-Crop Farming in Taiwan." Journal of Population Studies, 1:1-29, Taipei: Population Studies Center, National Taiwan University.

Yezer, A.M.J., and L. Thurston. 1976. "Migration Patterns and Income Change: Implications for the Human Capital Approach to Migration." Southern Economic Journal, 42:693-702.

Zelinsky, W. 1971. "The Hypothesis of the Mobility Transition." The Geographical Review, 61(2):1-31.

Zipf, G.K. 1946. "The P1 P2/D Hypothesis on the Intercity Movement of Persons." American Sociological Review, 11:677-686.