It is estimated that 15 million migrants displaced by development projects every year in the world. However, research on health impacts of project-induced displacement is insufficient. The existing literature concerning the causal effect of migration on health is inconclusive due to the selective nature of migration and other methodological problems.

This study employs the stress process model as the major theoretical framework, components from Cernea’s IRR model as well as Scudder and Colson’s framework are also incorporated to examine the short-term health impact of the displacement resulting from China’s Three Gorges Dam Project. I also explore whether the displacement’s effect on health is mediated by three secondary stressors, i.e., deterioration in social integration, SES, and community resources. To address the methodological problems typical in migration studies, we use the natural experiment design to collect pre- and post-migration data from both migrants and non-migrants (the control group). The pre–migration survey interviewed 775 designated migrants and 555 non-migrants in 2003. We successfully traced 1070 subjects in post-migration survey conducted in 2006.

Using the difference model and the structural equation modeling procedures as analytical strategies, we found that the displacement heightened migrants’ depression, and worsened their self-rated health. The displacement was also responsible for deterioration in social integration, socio-economic status, and community material
resources. The observed effects of the displacement on migrants’ health were mainly mediated by undesirable changes in social integration and income. This study suggests that social integration, a factor which has been overlooked in past studies, is at least as important as economic factors in affecting the health of the displaced. It also demonstrates the utility of the stress process model for studying mental and physical health of project-induced migrants in an Eastern culture setting.
DEDICATION

This dissertation is dedicated to my parents, Cao Ronggui and Fan Huizhong, who give me never-ending support and encouragement to pursue my dream. Although 17,000 kilometers away from them, my memory about them has been becoming clearer than ever before. The older in age, the better I understand them. Furthermore, in literature reading for my dissertation, I began to realize that how much suffering my parents’ generation has experienced in the past 60 years: wars, famines, revolutions, disastrous political movements, and so on. Without mention of anything about their sufferings, they always show me the bright side of the world. Most important of all, they stand righteous in such a radically changed society and make a role model for me.
ACKNOWLEDGEMENT

While writing the paragraph, I feel the rising tide in my heart. The past five and half years are going to settle in a photo album at the moment and never come back. In this album, I see many people to who I am so grateful.

Among them, my particular thanks are due to Dr. Sean-Shong Hwang, my advisor and dissertation committee chair, for his patience and effort to provide me not only the invaluable knowledge and research skills, but also the support in every aspect of my life. His own scholarship sets a high standard for me and he always encourages me to try my best to make everything as perfect as possible in my research. He spent countless hours on this dissertation since its beginning until the final version. Almost every paragraph contains his valuable advices and editorial efforts.

I also owe a great deal to each of the four members of my dissertation committee, Dr. William C. Cockerham, Dr. Patricia Drentea, Dr. David L. Roth, and Dr. John Waterbor for their insightful comments and patient guidance. I am fortunate to study in the Sociology Department in the University of Alabama at Birmingham, where I received a lot of help and inspiration through interaction with knowledgeable researchers and intelligent graduate students. In particular I would like to mention Dr. Cullen Clark, Tim Hale, Dr. Ferris Ritchey and Dr. Juan Xi for their support and encouragement.

Above all, I wish to thank my wife, Wu Jiaying, whose emotional and substantial support has meant so much to me. She has taken care of almost all the housework and
endured my anxiety during my dissertation writing.

The paper is too short to list all the people I am grateful to. My words are too shallow to express my gratitude to them. In the years to come, I hope that I can let them see their investment in me flourish.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>iii</td>
</tr>
<tr>
<td>DEDICATION</td>
<td>v</td>
</tr>
<tr>
<td>ACKNOWLEDGMENTS</td>
<td>vi</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>x</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xi</td>
</tr>
<tr>
<td>LIST OF ABBREVIATIONS</td>
<td>xii</td>
</tr>
<tr>
<td>CHAPTER</td>
<td></td>
</tr>
<tr>
<td>1 INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Brief History of the Dam Project</td>
<td>2</td>
</tr>
<tr>
<td>Negative Consequences of the Dam Project</td>
<td>4</td>
</tr>
<tr>
<td>The Focus of the Study</td>
<td>5</td>
</tr>
<tr>
<td>The Significance of the Study</td>
<td>6</td>
</tr>
<tr>
<td>2 LITERATURE REVIEW AND THEORETICAL FRAMEWORK</td>
<td>11</td>
</tr>
<tr>
<td>Development-Induced Displacement: Concepts and Overview</td>
<td>11</td>
</tr>
<tr>
<td>Development-Induced Displacement and Health: Theoretical Models</td>
<td>20</td>
</tr>
<tr>
<td>Scudder and Colson’s Framework</td>
<td>20</td>
</tr>
<tr>
<td>Impoverishment Risks and Reconstruction (IRR) Model</td>
<td>23</td>
</tr>
<tr>
<td>Stress Process Model</td>
<td>25</td>
</tr>
<tr>
<td>The Theoretical Framework of the Study</td>
<td>26</td>
</tr>
<tr>
<td>Primary and Secondary Stressors</td>
<td>28</td>
</tr>
<tr>
<td>Stress Outcomes</td>
<td>33</td>
</tr>
<tr>
<td>Social Integration and Health</td>
<td>35</td>
</tr>
<tr>
<td>Socio-economic Status and Health</td>
<td>39</td>
</tr>
<tr>
<td>Community Material Resources and Health</td>
<td>42</td>
</tr>
<tr>
<td>Research Model and Hypotheses</td>
<td>43</td>
</tr>
</tbody>
</table>
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Estimates of National Resettlement Caused by Development Projects</td>
<td>17</td>
</tr>
<tr>
<td>2</td>
<td>Demographic Profile of Household Sample and Census 2000 for WRDR</td>
<td>48</td>
</tr>
<tr>
<td>3</td>
<td>Attrition Equation for Missed Cases</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>Means, Deviations, and Bi-variate Correlations for Variables of Interest</td>
<td>59</td>
</tr>
<tr>
<td>5</td>
<td>DID Scores Measuring the Displacement’s Impacts</td>
<td>62</td>
</tr>
<tr>
<td>6</td>
<td>Sobel Test for the Unstandardized Indirect Effects in the Final Structural Regression Model</td>
<td>74</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Petersen’s Typology of Migration</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>Research Model for the Displacement and Health</td>
<td>45</td>
</tr>
<tr>
<td>3</td>
<td>Three Latent Factors Measurement Model of Change ($\Delta$) with the Standardized Solution</td>
<td>65</td>
</tr>
<tr>
<td>4</td>
<td>Two Latent Factors Measurement Model of Change ($\Delta$) with the Standardized Solution</td>
<td>67</td>
</tr>
<tr>
<td>5</td>
<td>Structural Regression Model of Displacement Effects on Changes in Depression and Health with the Standardized Solution</td>
<td>69</td>
</tr>
<tr>
<td>6</td>
<td>Trimmed Structural Regression Model of Displacement Effects on Changes in Depression and Health with the Standardized Solution</td>
<td>71</td>
</tr>
<tr>
<td>7</td>
<td>Final Structural Regression Model of Displacement Effects on Changes in Depression and Health with the Standardized Solution</td>
<td>72</td>
</tr>
</tbody>
</table>
**LIST OF ABBREVIATIONS**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CES-D</td>
<td>Center for Epidemiological Studies Depression</td>
</tr>
<tr>
<td>CFA</td>
<td>Confirmatory Factor Analysis</td>
</tr>
<tr>
<td>IASFM</td>
<td>International Association for the Study of Forced Migration</td>
</tr>
<tr>
<td>IRR Model</td>
<td>Impoverishment Risks and Reconstruction Model</td>
</tr>
<tr>
<td>PRC</td>
<td>People’s Republic of China</td>
</tr>
<tr>
<td>RMSEA</td>
<td>Root Mean Square Error of Approximation</td>
</tr>
<tr>
<td>ROC</td>
<td>Republic of China</td>
</tr>
<tr>
<td>SES</td>
<td>Socio-economic Status</td>
</tr>
<tr>
<td>SEM</td>
<td>Structural Equation Modeling</td>
</tr>
<tr>
<td>SRH</td>
<td>Self-Rated Health</td>
</tr>
<tr>
<td>SR</td>
<td>The Structural Regression Model</td>
</tr>
<tr>
<td>TGDP</td>
<td>Three Gorges Dam Project</td>
</tr>
<tr>
<td>TVA</td>
<td>Tennessee Valley Authority</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
</tr>
<tr>
<td>WRDR</td>
<td>Wanxian Relocation and Development Region</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

After 17 years of continuous work, the construction of the Three Gorges Dam Project (hereafter called TGDP or the Dam Project) on the Yangtze River in China is coming to the final stage. The Dam Project, 7575 feet long and 607 feet high, is the largest hydropower-complex project in the contemporary world (Jim and Yang 2006; Kahn 2006). With 32 hydraulic turbines, the Dam Project installed electric generating capacity will reach 22,400 megawatts, more than 10 times the capacity of the Hoover Dam. The three stated purposes of the Dam Project are:

1. To generate the hydropower to meet the rapid growing need of China’s economic expansion. It will lower the carbon emission by reducing the use of coal for power generation.

2. To facilitate development in China’s western and interior area by means of more efficient navigation systems. It will enable the voyage of 10,000-ton barges (instead of 1,500 tons in the past) between Shanghai and Chongqing (The largest metropolis in China), and to cut the transportation cost by 35%.

3. To control recurring floods in one of China’s most populated regions, which cost 327,594 life in 20th century.
Although the benefits of the Dam Project are far-reaching, the challenges of solving the environmental and resettlement problem are enormous. Completing the Dam Project creates a reservoir 398 miles long, that will completely or partially submerge 20 counties and cities, a total land of 244 sq miles, requiring a permanent displacement of 1.4 million\(^3\) people who live below the 574 feet above-sea-level in Hubei and Sichuan Provinces (Hwang et al. 2007; Tao 1994; Wang 2001). Although the Dam Project is one of the most controversial dam projects since its inception, the planning of a dam project in Three Gorges area on Yangzi River has a long story.

Brief History of the Dam Project

The Opium War (1839-1842) brought the most humiliating defeat in history to China, the aged and stumbling giant empire at that time. Since then, China suffered one defeat after another, one unequal treaty after another, until 1945. Obsessed by the collective memory of humiliation, China’s consistent theme for the national chorus in the past two centuries has been development, progress and modernization. The Dam Project is one episode in this chorus.

In 1919, Dr. Sun Yat-Sen, the founding father of the Republic of China (ROC), first suggested a dam in Three Gorges area to improve the navigation on Yangtze River and generate power in his *Strategy for State Building* (Yang 2007). After exploring the potential capability of electric power generation on Yangtze River, the Construction Committee of the Kuomintang (KMT) published *The Hydroelectric Generating Plan* in 1933, which proposed a dam with 300 megawatts installed generating capacity on the Yangtze River (Jones and Freeman 2000). However, the plan was put aside due to the

Just one year before the end of the Sino-Japanese War, Dr. Sun’s development program was once again put on the table. With the help of Tennessee Valley Authority (TVA), John Lucien Savage, a world-famous expert in dam construction, was invited to China to investigate the possibility of building a dam on Yangtze River. He suggested several possible sites in Three Gorges area and later put forward his *Preliminary Report on Development Plans of Three Gorges*, in which he writes:

“The Yangtze Gorge Project is a ‘CLASSIC.’ It will be of utmost importance to China. It will bring great industrial developments in Central and Western China. It will bring widespread employment. It will bring high standards of living. It will change China from a weak to a strong nation. The Yangtze Gorge Project should be constructed for the benefit of China and the world at large.” (Jones and Freeman 2000)

Only completing some preliminary work required for the project, the plan was again terminated because of the civil war between the Nationalists and the Communists.

After Communists took power and formed the People’s Republic of China (PRC) in 1949, Chairman Mao Tse-tung, the new leader, revived the thought of building a dam on the Yangtze River, but the chaos of following political movements and the Cultural Revolution buried it again until China’s economic reforms started in 1979. In 1982, the Dam Project was listed in the national development plan of China. However, the heyday of big dams was over in industrialized nations. Despite of the concerns from both within and outside of China, the Seventh National People’s Congress adopted *The Resolution to Construction of Three Gorges Project* in 1992, and started the construction in 1994. Now the Dam Project stands as a symbol of national pride.
Negative Consequences of the Dam Project

Although building the Dam Project to tame Yangtze River is the dream of Chinese for generations, the opposition against it is strong. With 166 delegates voting against it and about one third of the delegates abstaining, the Seventh National People’s Congress passed *The Resolution to Construction of Three Gorges Project* with the smallest margin in the PRC’s history in 1992 (Yang 2007).

One of the biggest challenges is the resettlement of 1.4 million TGDP-induced migrants. After years of constructing water conservancy projects since 1949, China had resettled over 10 million people by the late 1980s. Among them, 46% of the reservoir resettlers are living in poverty (World Bank 1994). The failed resettlement efforts of the past have led some critics to question China’s competence to resettle 1.4 million people for the Dam Project.

Although relocation of urban residents is relatively easy because their livelihood is portable, farmers, representing 40% of the total resettlement population, have to face a greater challenge due to the scarcity of farmland in the region. Three Gorges area is known for its shortage of arable land historically. Now with 100 sq miles farmland loss due to the Dam Project, the person-land relationship has become worse. Reclaiming farmland in steep hillside slopes is ecologically insensible. The rising water in TGDP reservoir leads to soil erosion, which has already caused landslides along the shores of the Yangtze River. Placement of farmers in non-farm jobs is also not feasible due to their low educational attainment and the under-developed economy in Three Gorges area. Chinese scholars warn that dissatisfied farmers may rise up in violence and shake the social stabilization (Wei 1999). Furthermore, the actual number of people who would
have to be resettled is expected to reach a lot more than 1.4 million. In response to the
deteriorated ecosystem, and increased incidences of riverbank collapses and landslides
directly tied to deforestation and erosion, in October 2007, Chinese government
announces that an additional 4 million people in TGDP reservoir will be encouraged to
relocate by the year 2020 to mitigate the environmental problems of TGDP reservoir area
(BBC NEWS 2007; Wang 2007). The additional resettlers are not called as “TGDP
resettlers,” but “ecological resettlers” or “natural disaster resettlers” in government
documents (Deng 2009). The current labels are misleading since they create a
misconception that these new resettlers have nothing to do with the Dam Project, and
divert people’s attention from the complex environmental, economic and political causes
behind the resettlement.

Besides the relocation of 1.4 million of people, the major negative consequences
of the Dam Project include: the collection of silt in the reservoir (Yang 2007), the loss of
valuable archaeological, cultural and beautiful landscape sites, the threat to aquatic and
riparian biodiversity (Wu et al. 2003; Xie 2003), and the possible environmental pollution
(Stone 2008).

The Focus of the Study

One aspect of the Dam Project with great sociological significance is the
resettlement of affected people in the TGDP area. Such magnitude of resettlement is
unrivaled in modern history. Although TGDP is a development project by the state, and
the Chinese government has responsibility to reconstruct migrants’ life, it is possible that
their life could slide into a refugees’ situation if without well-designed resettlement
scheme (Cernea 1996). The economic and social loss of development-induced migrants is well known and much studied (Cernea and Mathur 2008; Chakrabarti and Dhar 2009; Verma 2004), but the literature focusing on the impact of development-induced relocation on the health of those affected is considerably smaller. The purpose of this study is to find out whether TGDP-induced displacement influences its migrants’ health; and if there is an association, how it affects their health through intermediate factors.

The Significance of the Study

While it is not easy to ascertain the Dam Project’s effects in hydrology, ecology, and environment empirically, the impact of the Dam Project on those resettled is more difficult because of the lack of information and the lack of the proper research tool. Environmentalist groups and human right protection groups have devoted many articles to the plight of the resettlers since the Dam Project inception, but they are not done systematically and do not provide a complete picture for the resettlement. Although I find a growing Chinese literature on this topic (see Li, Waley, and Rees (2001) and Feng (2006) for a review of Chinese literature), most of them lack scientific rigor in terms of common standards applied in the United States social science field. According to Luo (2005), among those TGDP resettlement studies, most of them are not empirical research, but some opinions or advice for government. The external scrutiny of the impact of TGDP-induced displacement in English literature is considerably limited (Duan and Steil 2003; Gleick 2009; Hwang et al. 2007; Jim and Yang 2006; Li and Rees 2001; Xi et al. 2007).

There is a long tradition of research concerning the role of migration in health
and illness, but the empirical evidence about their causal relationship is still problematic (Kasl and Berkman 1983; Kinra 2004). First, the findings are inconsistent. While many studies find migration to be associated with the development of diabetes, hypertension, hyperlipidemia, ischemic heart disease, and psychological disorder (Bhugra 2004; Elford and Ben-Shlomo 2004; Fall 2001; Odea 1992; Salmond et al. 1985; Schooling et al. 2004), others suggest no such link (Anson 2004; Desjarlais et al. 1995; Kuo and Tsai 1986; Rosenwaike 1990). Clearly the relationship between migration and health is anything but unequivocal given the diversity of migration. In past studies of migration and health, migration status (migrants vs. non-migrants) was used as an independent variable. This framework conceals the variability of migration consequences: those who are exposed to the same migration experience might not be exposed to the same secondary stressors proliferated during or after migration. Although migration status is found to be related to health, a failure to differentiate migration from its secondary effects makes it difficult to discern which particular stressors were actually responsible for the observed outcomes. It is necessary to pinpoint which specific stressors are more likely to result in poorer health. This study will contribute to the literature by identifying three potential secondary stressors (i.e., undesirable changes in social integration, socio-economic status, and community material resources) and making an attempt to separate them from the general measure of migration status.

Second, the weak research designs used in past studies of migration had plagued the interpretation of their findings (Conley, Strully, and Bennett 2003; Hwang et al. 2007; Kasl and Berkman 1983). Migration’s effect on health is confounded with many factors including selection bias, environmental differences, psychosocial and biological
characteristics of migrants. However, it is often not easy to disentangle them. As early as in 1979, Hull (1979) has pointed out the endogeneity problem in the research of migration and health: while migrants’ health can be affected by migration, the health status of individuals may also influence migration decision. Furthermore, the choice of different comparison groups (e.g. those in the sending and receiving communities) may lead to different findings. Studies which overlook these factors are likely to get inconclusive results. According to Kasl and Berkman (1983), the “natural experiment” is an ideal design for migrant health study, but such design is rare due to practical difficulties of knowing who is going to move and gathering the pre-migration data from them in advance. The longitudinal Family Life Surveys conducted in Mexico (Rubalcava et al. 2008) and Indonesia (Lu 2008) used nationally representative longitudinal data to test whether migrants are healthier than those who stay behind. Although their studies minimize the endogeneity problem, they are cost-inefficient since they required very large sample sizes in order to capture enough numbers of migrants for meaningful comparisons. Besides, they only focus on voluntary migrants.

TGDP-induced displacement provides a golden methodological opportunity to conduct a natural experiment to study involuntary resettlers’ health. Since all the residents living below an altitude of 175 meters would have to migrate without exception, migration in this case is a pure exogenous variable. Because the TGDP-induced migration is a well-scheduled event, it enables us to collect data for the initial differences between migrants and non-migrants before relocation. In the natural experiment design, the possibility of gathering pre-migration measures helps to rule out the pre-migration differences between migrants and non-migrants as a potential confounding factor.
Furthermore, by using non-migrants from the same region as the comparison group, it helps to remove the effects of intrinsic factors such as history, maturation, and experimental mortality. As a result, it is possible to separate the role of migration from other factors or alternative explanations for the observed association between the variables of interest. Thus, this study promises to extend the existing knowledge regarding the determinants of the health effects of involuntary migration.

Third, most studies examining the link between migration and health have been conducted in Western industrialized countries, which limits the generalization of results to other cultures. In the past fifty years, migration has become a dramatically increasing phenomenon in Asia, motivated by both political and economic factors. Although Asia has the largest population movement in the world, there is limited literature about migration and health in Asia (Jatrana, Toyota, and Yeoh 2005). Safman (2008) argues that such a gap in the literature is unfortunate because both public health and social sciences are slow to acknowledge the Asian migrants’ health problems. To gain a better understanding of whether the existing explanations of the relationship between health and migration observed in Western societies can be applied in Eastern culture settings, we need more empirical research focusing on this topic in Asia. The TGDP-induced migration presents a valuable opportunity to understand the relationship between migration and health in a different socio-cultural environment.

In sum, there are at least three reasons for studying the health of TGDP-induced migrants: first, the study will explore how a development-induced displacement changes people's health through changing their social integration, socio-economic status, and community material resources. It helps us to sort out the relative impact of these
secondary stressors implicated in illness onset. Second, the Dam Project provides a rare opportunity to conduct a natural experiment, which can help us avoid the methodological difficulties usually encountered in the study of the relationship between migration and health. Third, my study will extend our knowledge about displacement’s effects on health to a different cultural context.
CHAPTER 2

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Development-Induced Displacement: Concepts and Overview

To better understand the development-induced displacement, we need to locate its position in the migration spectrum. I will first address the similarities and differences between voluntary and forced migration (or involuntary migration).¹ I will then differentiate development-induced displacement from other types of forced migration. Finally, I will present the importance of development-induced migrants’ health study.

There are two general types of migration: voluntary and forced migration. Voluntary migration is mainly about economic migration (Castles 2003), while forced migration has three major subcategories: development-induced displacement, conflict-induced displacement, and disaster-induced displacement. Terms such as displacement, relocation, resettlement, and dislocation have been used inconsistently in forced migration literature. People who migrated involuntarily have been referred to as resettlers, relocatees, displaced persons, displacees, oustees, refugees, asylum seekers, and migrants. The International Association for the Study of Forced Migration (IASFM) encourages a set of terminology to be used consistently, but some of the terms mentioned above are still being used interchangeably, creating difficulties in literature search.²

It is not always easy to draw a clear cut between forced and voluntary migrants (Kristiansen, Mygind, and Krasnik 2007; Thomas and Thomas 2004; Turton 2006). Most voluntary migrants are need-driven, who are partially “forced” to migrate by such “push”
factors as a deteriorated community, a lack of employment opportunities, a poor school system, or political instability. The Polish migrants after World War II, while normally considered voluntary, were partially “forced” because of the hopelessness that prevailed in Poland brought on by political and economic turmoil (Lobodzinska 1986). In the epoch of globalization, Castles (2003) argues that the distinction between forced and voluntary migration becomes more blurred because social inequality, maintained and exacerbated by globalization, is the same cause for both forced and voluntary migration.

All categories of migration, voluntary or forced, like other human behaviors, are a result of social constraints. Eichenbaum (1975:22) believes that there is no totally voluntary migration because “in reality all decisions contain a superindividual component” in that individuals’ behavior is affected by family upbringing, cultural biases, and other social constraints. At a general level, all migrants are similar in that they leave the places they are familiar with and experience the life disruption in the process of adaptation to their new residence. Oliver-Smith and Hansen (1982:3) maintain that, “all migration implies some degree of prior relative deprivation. People decide to move away because some needs or desires are not being adequately fulfilled in their present location.” The difference between voluntary or forced migration lies in the degree of such social constraints and prior relative deprivation.

In his classic work, Petersen (1958) includes individual’s level of aspiration and his power of decision into consideration. He develops an elaborate typology for different types of migration (see figure 1).
Figure 1. Petersen’s Typology of Migration
In his typology, “forced migration” is one of the classes of migration, which is not exactly corresponding to the forced migration concept used in current migration studies. The three major subcategories of forced migration mentioned above (i.e., development-induced displacement, conflict-induced displacement, and disaster-induced displacement), are not defined directly in his typology, but implied in his three classes of migration: “forced migration,” “impelled migration,” and “primitive migration.” Petersen (1958) argues that the ecological pressure is the causal agent of “primitive migration,” which shows people’s inability to “cope with natural forces” (p259); the causal agent of “forced migration” and “impelled migration” is “the state or some functionally equivalent social institution” (p261). The difference is that “forced migration” people do not have any power to refuse migration, while they have some power of decision in “impelled migration.” It seems that he has no interest to make a clear-cut distinction between voluntary and forced migration.

According to Richmond (1988; 1994), it is useful to see migration on a continuum encompassing a wide variety of forms. At one end is “reactive”: individuals are totally forced to move with no alternative option; at the other end is “proactive”: individuals can freely access relevant information and carefully weigh the costs and benefits before making a migration decision. Ryan, Benson, and Dooley express the same thought in terms of push-pull factors:

“Forced migrants are distinguished from voluntary ones by the greater level of push versus pull factors that determine their decision to migrate. In other words, forced migrants flee to avoid aversive aspects of their home environment, whereas voluntary migrants are attracted by positive aspects of the host environment” (Ryan, Benson, and Dooley 2007:113).
Oliver-Smith and Hansen (1982) emphasize two important distinguishing factors between forced and voluntary migration: first, forced migration is characterized by the diminished power of decision; second, forced migrants are short of a original motivation to leave their place of residence. Another noticeable difference is that voluntary migration is usually self-selective to those who are willing to pursue new opportunities and are better able to adapt themselves to the new environment, while the forced migration is indiscriminate and involves the whole community, no matter of their age, gender and ability to handle the new life (De Wet 1995; Guggenheim and Cernea 1993).

The International Association for the Study of Forced Migration (IASFM) defines forced migration as “a general term that refers to the movements of refugees and internally displaced people (those displaced by conflicts) as well as people displaced by natural or environmental disasters, chemical or nuclear disasters, famine, or development projects” (Roberts 2003). This definition suggests three types of forced migrants: refugees, internally displaced people by conflicts, and internally displaced people by development projects and disasters.

The United Nations (UN) defined “refugee” in 1951, “as a person who owning to well-founded fear of persecution for reasons of race, religion, nationality, membership of a political social group, or political opinion, is outside the country of his/her nationality, and is unable or owning to such fear unwilling to avoid him/herself of the protection of that country” (Kalaitzidis 2006). Internally displaced people by conflicts face the same situation as refugees. They leave their homes to avoid persecution, violence, and violations of human rights due to the conflicts, but they remain in their own countries. Turton (2006) prefers to called them “internal refugees.”
Internally displaced people by development projects and disasters are the consequence of two types of forced migration: disaster-induced displacement and development-induced displacement. The causes of disaster-induced displacement could be natural (e.g. earthquakes, floods, tsunami, volcanoes), or man-made (e.g. industrial accidents, chemical or nuclear pollution, deforestation).

Bose (2003) defines development-induced displacement as “The forcing of communities and individuals out of their homes, often also their homelands, for the purpose of economic development.” Now social scientists further recognize that development-induced displacement could happen even if nobody loses any physical property. For example, a new environment conservation park prohibits the local residents from using lands and resources for living, or a new factory changes the ground water levels, which is vital to the agricultural livelihood in the area. Such examples would not be forced displacement in the classical sense because it does not lead to imposed expropriation of people’s land or house as part of the project plan itself. However, since it restricts people’s access to the resources vital to their livelihood and imposes severe deprivations to them, now it is regarded as a form of forced displacement (Cernea 2005; Chakrabarti and Dhar 2009). It is reflected in the revised World Bank Operational Policy 4.12 on resettlement in 2002, which differentiates between “physical displacement” and “economic displacement.” Physical displacement refers to the forced displacement with physical removal in the common sense, while economic displacement happens when the forced restriction of access to resources leads to imposed deprivation of assets and income (Chakrabarti and Dhar 2009).

Although there is some overlapping between development-induced displacement
and other forms of forced migration, development-induced displacement is different from others in three perspectives: first, it is a planned process and lasts for a period of time; second, people displaced by development projects usually have little hope to return to their original communities; third, the government or other developers have a clear obligation to ensure the displaced people fully compensated and their life rehabilitated.

The focus of this study is the effects of development-induced displacement on displacees’ health. Development-induced displacement is the largest subcategory of forced migration in the world in terms of its scale. According to Cernea (1990), it is reasonable to estimate that there are one to two million people each year displaced by development projects in the world. Although the number is enormous, it continues to rise due to the growing economies and the rising populations. The number of global development-induced migrants is updated to 15 million annually (Cernea 2006). Table 1 combines the data from Guggenheim and Cernea (1993) and Cernea (2006), which shows an attempt to quantify the development-induced displacement of larger developing countries.

Table 1. Estimates of National Resettlement Caused by Development Projects

<table>
<thead>
<tr>
<th>Country</th>
<th>Time Period</th>
<th>Number of People</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>1950-2005</td>
<td>70,000,000</td>
</tr>
<tr>
<td>India</td>
<td>1950-2005</td>
<td>60,000,000</td>
</tr>
<tr>
<td>Thailand</td>
<td>1963-1977</td>
<td>130,000</td>
</tr>
<tr>
<td>Brazil</td>
<td>1980-1990</td>
<td>400,000</td>
</tr>
<tr>
<td>Turkey</td>
<td>1980-1990</td>
<td>300,000</td>
</tr>
</tbody>
</table>
Sociological research of development-induced displacement is justified not only because of the number of people involved, but also because of the unequal distribution of costs and benefits brought by the development projects. People displaced by development projects, bear most of the cost, but don’t get the most benefits (Cernea 2000). The rationale of “development” is to reduce the poverty and improve people’s life, but ironically development-induced displacement often makes those displaced ended up in miserable life. De Wet believes that, “in the overwhelming majority of cases, most of the people displaced or resettled by development projects are still left worse off than before and suffer socio-economic impoverishment” (De Wet 2006:1). For example, it is estimated that after India’s independence, 75 percent of the displaced people for development projects were either turned into poverty or death (Chakrabarti and Dhar 2009). World Bank indicates that 60 percent of those who had been displaced by dam projects lived below poverty line in China (Robinson 2003). The social inequality is well presented in the development-induced displacement: development projects are usually built in the underprivileged communities and underdeveloped areas, while the wealthy communities and the developed regions enjoy most the advantages brought by development projects. Among the displaced, those poor and powerless are the most vulnerable to the displacement suffering.

Despite its sociological ramifications, displacement research has been dominated by economists and geographers (Castles 2003). Research on health impacts of project-induced displacement is especially insufficient. Jayewardene (1995) notices such research has come only when the health problem reaches a crisis point. She further contends that even those people affected do not pay enough attention on health issues and
they usually put material and economic issues as their priority. However, this neglect does not make health research in development-induced displacement any less important. Scudder notices that:

“the incidences of poor nutrition and disease, as well as higher death rates, have increased immediately after resettlement, or have occurred later where public health initiatives are lacking or impoverishment results” (Scudder 2005:24).

The negative health impacts of displaced populations can be long lasting. Almost 200 years since The Indian Removal Act, American Indians still suffer from the low life expectancy and high rates of morbidity, depressions, suicide, and alcohol addiction (Fernandes 1996).

Another reason to focus on health in development-induced displacement is a methodological one. Qualitative research has dominated health study of forced migration. It is not easy to apply quantitative methods, because of the difficulty to collect reliable data under the situations of conflict and insecurity (Castles 2003). Besides, forced migration often happens in emergency, and does not last for long. It is rarely possible for researchers to get pre-migration data. As a result, it is uncommon to study the health impact of forced migration. A few existing studies are restricted to anecdotal reports and case studies (Scudder 2005). However, project-induced displacement is an exception because it is planned and lasts for a period of time, researchers may have chance to conduct quantitative research on the health of those affected. With reliable data and superior design, the quantitative research can provide solid evidence of causality, and make an inference for the population.

The TGDP-induced displacement represents one extreme of the migration
continuum in that the migration decision was not made by the affected people, but by the Chinese central government. Furthermore, there is no alternative option available for TGDP-induced migrants. They have to move because their home will be submerged under the water permanently. Although the Dam Project is a development project by the state, and the Chinese government has responsibility to reconstruct migrants’ life, the health of the displaced could slide into a terrible situation without adequate attendance and assistance.

Development-Induced Displacement and Health: Theoretical Models

Most migration theories focus on voluntary migration emphasizing migrants’ motivation, decision-making, and social dynamics of the migratory process with the assumption of ‘rational choice’. Such theories may not be fully applicable to forced migration (Richmond 1988; Shuval 2001). Forced migration study tends to be atheoretical and has been accorded a peripheral status by mainstream sociology (Black 2001; Castles 2003). Research focuses on development-induced displacement tended to be applied-oriented (Cernea 1993; Hansen and Oliver-Smith 1982). However, there is a growing body of literature that has demonstrated the utility of three different theoretical models in analyzing forced migration’s effect on health, i.e., Scudder and Colson’s framework, Cernea’s Impoverishment Risks and Reconstruction (IRR) model, and the stress process model.

*Scudder and Colson’s Framework*

Thayer Scudder and Elizabeth Colson develop a framework for analyzing the
displacement (Colson 1971; Colson 1987; Scudder 1985; Scudder 1991; Scudder 2005; Scudder and Colson 1982). Since mid-1950s, they begin to study the resettlement of Gwembe Tonga people, which was caused by the Kariba dam project across the Zambezi River in Central Africa. This study, still in progress, has become one of the most detailed long-term studies on the development-induced displacement. Colson’s book, Social Consequences of Resettlement: The Impact of the Kariba Resettlement Upon the Gwembo Tonga, is “the best single case study of dam resettlement” (Scudder 2005: 327). Their model has an important influence on scholars and policy-makers in the fields of development-induced displacement (De Wet 1995).

Basically, they contend that displacement experience will cause stress, which is of a “multi-dimensional” nature, including physiological, psychological and socio-cultural stress. Physiological stress means “the various health impacts associated with removal” (Scudder 2005:25). Psychological stress has four aspects: “trauma,” “guilt feelings,” “the grieving for a lost home,” and “anxiety about an uncertain future.” The first two aspects are most likely to present in conflict-induced displacement, while the other two are common in development-induced displacement (Scudder and Colson 1982:269-270). Socio-cultural stress is “associated with the economic, political, and other cultural effects of relocation” (Scudder and Colson 1982:270). They believe that people’s responses to migration, whether forced or voluntary, are predictable and similar in a broad sense, but the forced migrants may suffer more problems and stresses than other types of migrants (Scudder 1985: 126). They also recognize the importance of coping resources, both economically and psychologically, which make the impact of resettlement varied in different groups even facing the same type of resettlement (Scudder and Colson
To systematize the predictable responses of people displaced, Scudder and Colson develop the following 4-stage framework to explain the successive stages of a successful resettlement:

1. Planning and recruitment stage;
2. Adjustment and coping stage;
3. Community formation and economic development stage;

The displacement stress is the central role in the first two stages, and especially the second stage, which is a major period of experiencing stress (De Wet 1995). During the first two stages, displaced people tend to adopt “conservative” strategies to cope with the stress. For example, two commonly used strategies are “business as usual,” which denies the fact of coming displacement, and “cultural involution,” which cling to the familiar and change as little as possible (Scudder and Colson 1982:271-273). In the third stage, people are behaving in “risk-taking” and “open-ended” way instead of a “conservative” stance. This stage comes when the living standards of most displaced people have been recovered as before displacement. The fourth stage signifies the success of the resettlement, which involves the second generation of those displaced. However, most of the development-induced displaced can’t reach the third and fourth stages because few resettlement projects are successful (Scudder 2005; Scudder and Colson 1982).

This framework has been used in the study of the Papaloapan dam resettlement project (Partridge, Brown, and Nugent 1982). It was found that health disparity
intensifies in the third stage. In Scudder and Colson’s studies, they find the displacement stress have differential consequences on mental health across socio-economic status (Scudder and Colson 1982), gender (Colson 1991), and age (Colson 1991).

*Impoverishment Risks and Reconstruction (IRR) Model*

Scudder and Colson’s framework is a behavioral model, which focuses on the displacees’ responses in a successful resettlement. However, so few resettlements complete the third and fourth stages. The repeated failures of resettlement suggest the need of a new model for the development-induced displacement schemes. Cernea’s IRR model (Cernea 1996; Cernea 1997; Cernea 2000) plays a major role in this task since the 1990s.

The IRR model is different from Scudder and Colson’s framework in that it does not distinguish varied stages of forced migration. Instead, it attempts to identify the intrinsic risks of impoverishment systematically through forced migration process, and to create a theoretical tool to help restore the life of the displaced after relocation. The model identified eight impoverishment risks commonly accompanied population displacement: “landlessness, joblessness, homelessness, marginalization, increased morbidity and mortality, food insecurity, loss of access to common property, and social disintegration” (Cernea 1997). These eight areas are not mutually exclusive, but interlinked with each other.

In the IRR model, the risk of increased morbidity and mortality directly addresses the adverse health effects associated with the development-induced displacement. The health of those displaced by dam projects in tropical area tends to
deteriorate from parasitic and vector-borne illnesses (e.g. malaria and schistosomiasis), and from poor hygiene related infectious diseases (e.g. diarrhea and dysentery). For instance, after a dam-induced resettlement in the Akosombo area in Ghana, the schistosomiasis prevalence increases by 73 percent to 75 percent among adult lakeside dwellers (Cernea 2000). Rew and Driver (1986) report that gastroenteritis broke out along the Victoria dam reservoir in Sri Lanka. The risks of landlessness, joblessness, homelessness, and loss of access to common property belong to economic sphere, but they can cause the decline of health status in two ways: first, they impose high stress on the displaced people to affect their mental health; second, they relate to the food insecurity risk (undernourishment), which will in turn reinforce displaceses’ vulnerability to illnesses. The marginalization and social disintegration risks can heighten psychological stress from losing social status, self-esteem, community integrity, and mutual support.

From the discussion above, we can find the IRR model’s flexibility of interlinking eight risks together to analyze the development-induced displacement’s adverse effects on health. Mahapatra (1999) applies the model to India’s forced migration, and reports that comparing with non-displaced families, people displaced by development projects suffer from higher incidence of respiratory illnesses and gastrointestinal disturbances in Singrauli area, and from higher prevalence of malaria, fluorosis, guinea worm, and schistosomiasis in dam and irrigation projects area.
Stress Process Model

The stress process model is mainly used in voluntary migrants’ health study (e.g. Ben-Sira 1997; Noh and Avison 1996), only with a few applications in development-induced displacement (e.g. Hwang et al. 2007). This model can be traced back to the work by Pearlin (1989), and Lazarus and Folkman’s (1984). The stress process model consists of three conceptual domains: stressors, psychosocial resources, and stress outcomes. Because the link between stressors and stress outcomes is often indirect and contingent upon other factors, psychosocial resources are invoked to explicate the indirect and conditional association (Thoits 1995; Turner and Lloyd 1999). Chalmers suggests that stress is the “imbalance resulting from the interaction of four components: internal needs and values, external environmental demands and constraints, personal resources or capabilities, and external environmental supplies and supports” (1981: 333). Thus, the migration stress is associated with the demands confronting migrants as well as the personal and environmental resources migrants have in coping with the demands. Migrants experience many changes: including changes in culture, employment, psychological state, physical space, and lifestyle. Because migration requires changes in almost every aspect of life, and some unexpected, abrupt changes (e.g. different climate, dialect barrier) may exceed the capacity of migrants, it is impossible for migrants to prepare adequately by “anticipatory socialization” (Merton 1968). As a result, even for well-organized development-induced displacement, anticipatory preparation is insufficient to cope with all the changes.

While the stress process model encompasses mental distress resulting from a wide range of stressors, Berry (1997) focuses on the cross cultural migration stressor to
develop his “acculturation framework” based on the stress process model. His framework guides a lot of studies on immigrants’ health (e.g. Myers and Rodriguez 2002; Organista, Organista, and Kurasaki 2002). In recent years, another theoretical model, the “resource-based model” (Ryan, Dooley, and Benson 2008), has become increasingly influential in the study of refugees’ psychological well-being. The stress process model forms the foundation of this new model, which also add the elements from Berry’s framework and Hobfoll’s (1989; 2001) conservation of resources theory. The “resource-based model” presents us the possibility that the stress process model can be extended to the forced migration and mental health study in that the model regards the migrants’ adaptation as a process of resource losses and gains in the context of personal needs, goals and demands.

The Theoretical Framework of the Study

This study employs the stress model as the major framework, but combines components from the IRR model as well as Scudder and Colson’s framework. It is clear that migration, forced or voluntary, will produce dramatic changes to migrants’ life, but there is an argument about whether all the changes contribute to the stress of migrants. Some scholars emphasize the importance of change itself and predict all life changes, including the benign ones, emanate stressfulness (Dohrenwend 1975; Holmes and Rahe 1967; Selye 1982). They argue that all life-changes, regardless of their quality, are stressful because they disrupt life patterns and require that the organism adapt to the changes. However, other social scientists maintain that whether or not changes are stressful depend on their psychological and social meanings (Pearlin 1989; Thoits 1995). For example, Menaghan contends:
“Accumulating research using both physiological and psychological outcome measures suggests that change per se may be neither necessary nor sufficient for the experience of stress. Rather stress occurs to the extent that environmental demands tax or exceed the adaptive capacities or resources of the person, and/or environmental opportunities constrain the satisfaction of individual needs.” (Menaghan 1983: 158)

Through studying the effects of different life events, Mirowsky and Ross (2003) also conclude that the undesirability of events is significantly associated with distress, while desirable events, ambiguous events, change per se, and the number of events experienced are not especially significant. In migration studies, although the literature on the association between migration and stress is abundant, it is still not clear whether migration itself is the cause of stress, or whether some other burdens associated with migration lead to stress (Ben-Sira 1997). According to Desjarlais and his colleagues (1995), migration itself does not necessarily lead to distress, rather, distress is related to a series of factors including changes in employment status and social integration, as well as the experiencing of traumatic events during the migration process.

In this study, I argue that it is not only displacement itself, but also the proliferated stressors of displacement that should be regarded as causes of distress. From the literature review of theoretical models, we can see that the IRR model successfully identifies the negative consequences of displacement, while the merit of Scudder and Colson’s framework is to notice the psychological stress through “the grieving for a lost home” and “anxiety about an uncertain future” bought by development-induced displacement in the first and second stages. However, both models do not make the in-depth analysis on the displacement’s effect on people’s health. This study makes an attempt to combine the elements from the IRR model and Scudder and Colson’s
framework on the basis of the stress process model to analyze the primary and secondary stressors. My study will focus on three social factors as secondary stressors: the undesirable changes in social integration, socio-economic status, and community material resources.

*Primary and Secondary Stressors*

Stressors refer to “any environmental, social, or internal demand which requires the individual to readjust his/her usual behavior patterns” (Thoits 1995:54). According to Pearlin, it is useful to distinguish primary and secondary stressors: “whereas primary stressors can be conceptualized as occurring first in experience, secondary stressors come about as a consequence of the primary stressors” (Pearlin 1989: 248). A more detailed framework of stress proliferation is introduced by Pearlin and his colleagues (Pearlin, Aneshensel, and Leblanc 1997; Pearlin et al. 1990), in which primary stressors refer to stress-arousing demands that are directly rooted in the acute or chronic stressful event, while secondary stressors, in contrast, are defined as stressful experiences that are triggered by primary stressors. Such stress proliferation process is identified by many studies. For instance, separation and divorce can lead to financial strain (Pearlin and Johnson 1977); the death of a spouse will contribute to the isolation of survivors (Pearlin and Lieberman 1979); involuntary job loss may result in marital conflict (Pearlin et al. 1981); the hardship in caregiving tends to exert role strains, social life restriction on caregivers (Bookwala and Schulz 2000; Pearlin et al. 1997).

Making a distinction between primary and secondary stressors can help us understand why the well-being of migrants appears to be differentially affected by the
seemingly same migration process. Because not all migrants exposed to the primary stressor are also exposed to the same secondary stressors, the distinction between primary and secondary stressors helps to explicate the causal linkages between stressful conditions and stress outcomes.

Forced migration has long been seen as a stressful event that affects migrants’ well-being because it relocates the movers from a familiar environment to an unfamiliar one and forces them to readjust (Ben-Sira 1997; Bhugra 2004; Handlin 1951; Hull 1979; Hwang et al. 2007; Lev-Wiesel 1998; Xi et al. 2007). The TGDP-induced displacement in itself can be seen as a primary stressor, because it is an uprooting and irreversible process. The hardship experienced in the migration process can weaken the function of immune system resulting in increased vulnerability, and increase the chance of injury. The forced migrants are also victims of powerful external forces over which they have little or no control (Cernea 1993). The passive role of migrants may lead to the “anxiety over the future” (Scudder 2005). The coercive nature of the displacement adds to the stressful experience of TGDP migrants. The displacement brings about an abrupt change that upsets the ecological equilibrium. For TGDP migrants, displacement means the permanent loss of their home. The environment they are familiar with since childhood will be submerged under water forever. According to Magwaza and Bhana (1991), loss of their home is particularly stressful to migrants, and the stress of losing a home is second to death and serious illness in the family. Fried’s study finds the affective reactions to loss of home can reach the same intensity level as that of loss of a spouse (Fried 1968). Scudder (2005) labels it as “the grieving for a lost home syndrome” in their framework. Furthermore, the Dam Project affects only certain segments of a population based on
residential locations, it inevitably arouses a sense of injustice among those who are singled out for displacement (Albrecht 1995; Murdock, Krannich, and Leistritz 1999). In summary, I regard the displacement itself as a primary stressor because of the possibility that it can generate stress from the anticipation of miserable future, the nostalgia of lost home, a sense of injustice, the hardships experienced in the resettlement procedure.

In addition to its direct effects, forced migration often has negative economic and social consequences (Cernea 1997; Hansen and Oliver-Smith 1982; Hwang et al. 2007; Xi and Feng 2001). The IRR model provides a systematic review on those negative consequences in its eight areas of risks. However, the eight areas does not include all risks migrants might encounter (Cernea 2000). For example, some scholars (Robinson 2003; Scudder 2005) suggest that the loss of access to community services can be regarded as a risk. In this study, I employ three secondary stressors (i.e., the undesirable changes in social integration, socio-economic status, and community material resources) to conceptualize the risks migrants experienced. Negative social integration change focuses on the risk of social disintegration in the IRR model; socio-economic status change reflects the risks of landlessness, joblessness, homelessness, marginalization, food insecurity, and loss of access to common property; community material resources change reflects the risk of loss of access to community services suggested by other scholars.

Because of the ecological constraints at TGDP resettlement sites and logistic challenges in relocating communities in whole units, it is necessary to break villages apart and send villagers of the same clan in fragments to diverse destinations. The social integration embedded in migrants’ social network may suffer a dramatic drop. Because the resettlement decreases migrant’s social integration when it is most needed, I have
reason to regard it as one of the secondary stressors.

Furthermore, China is known for its high agricultural density and labor-intensive farming (Brown 1995; Zhu 1996). The population in the TGDP area is crowded and farmers average merely one *mu* (1/15 of a hectare) of farmland per capita. The Dam Project will submerge 25.9 thousand hectares of mostly fertile farmland. It is reported that many farmers who had moved uphill suffered from a significant drop in living standard because of the degraded land on the mountains produces smaller harvest (Yardley 2007). It is also difficult for the ousted farmers to be absorbed by non-farm industries because they usually have neither the skills nor the qualifications for such jobs. In addition, factory jobs are scarce in this region (Tao 1994). Although government made efforts to create factory jobs in the region, according to recent reports they have been proven unsuccessful, and many displaced farmers have become jobless and landless after the displacement (Cao 2007; Cody 2006; Hu 2006). As a result, the worsened socio-economic status after the displacement could be a secondary stressor on migrant’s health.

Finally, migrants’ access to community material resources (for example, access to healthcare, shopping, and education) in the destination can be affected by factors like language, psychological discomforts, and socio-cultural barriers. Although TGDP migrants relocate within China, the diversity of local dialects can create communication barriers for the relocated. The difference in socio-cultural knowledge may further contribute to the difficulties in communication and mutual understanding. Psychological discomforts may present after relocation due to lack of trust and difficulties in social interaction. All these barriers can interact to constrain migrants’ access to community’s healthcare, shopping, education, and entertainment resources after the relocation.
Because the restriction of access to community material resources will also lead to poorer health outcome (Berkman and Kawachi 2000; Ross and Wu 1995), I argue it makes another secondary stressor.

Before I turn to discuss fully the relationship between health and the three secondary stressors (i.e., social integration, socio-economic status, and community material resources), I must first clarify why I conceptualize these factors as secondary stressors given that these same factors are often referred to as mediators or coping resources in the stress process research.

Secondary stressor as a concept suggests a clear and strong causal relationship with primary stressor. The concept of mediator, on the other hand, is vaguer because it can imply more than one possible relationship with the primary stressor. For example, Ensel and Lin (1991) propose six possible ways that mediators work in the stress process model. Among their six models, the deterioration model is the only one which clearly suggests a causal relation between the primary stressor and distress using resources deterioration as secondary stressors. The use of secondary stressors instead of the vague concept of mediators makes explicit that resources deterioration is a direct outcome of the displacement as a primary stressor. Furthermore, because of the advantages of the natural experiment design, the causal link between primary stressor to secondary stressors can be empirically verified.

The names mediator and secondary stressor also suggest different theoretical orientations. The secondary stressors emphasize the consequences of involuntary migration as a highly social-constrained stressor. It breaks down migrants’ social integration, demotes their socio-economic status, and narrows their access to community
resources. In contrast, mediators simply imply that migrants use available resources to govern the effects of stressors on stress outcomes. Because one of the purposes of this study is to show the social consequences of involuntary migration, it would be better to regard the negative changes in social integration, socio-economic status, and community material resources as a consequence of forced migration.

Stress Outcomes

According to Pearlin (1989:252), stress outcomes refer to “the manifestations of stress.” Although there are different forms of stress manifestation, depression is the most commonly used one and represents the primary interest of sociological studies of stress (Kessler et al. 1994; Thoits 1995; Turner and Lloyd 1999; Vega and Rumbaut 1991). Health is another important indicator of stress outcome. However, the association between stress and health is less obvious when applied to the medical domain, in which researchers have historically drawn a separation between body and mind.

Since the 1930’s scholars in Psychosomatic Medicine began to question this separation and examine the relationship between psychosocial factors and disease processes (Levenson 1994). In 1977, George Engel published his classic in Science, “The Need for a New Medical Model,” to propose a “biopsychosocial model,” which has become one of the cornerstones for the interdisciplinary study of human health from social, psychological, and biological perspectives. Since then, there is increased interest on the study of health as a stress outcome. As a matter of fact, as early as in 1930’s and 1950’s, Cannon (1932) and Selye (1956) have already identified the relationship between socio-environmental stressors and the physiological functioning of individuals.
According to their research, the nervous system is affected by noxious physical or social stimuli. If these stimuli are extreme or prolonged, they can cause changes in bodily tissues through physiological adaptations to negative stimuli (House 2001). The process involves the autonomic nervous system and neuroendocrine system. The former controls heart rate, blood pressure, and gastrointestinal functions through parasympathetic and sympathetic systems, while the latter secretes hormones directly into the bloodstream to control heart rate, blood pressure (Cockerham 2007). Once an individual experiences the negative physiological adaptations as a result of stress situations, certain unhealthy results like obesity, hypertension, heart disease, or reduced functioning of the immune system might happen. Another explanation of why stress leads to poor health is reactivity hypothesis. It suggests the stress exaggerates cardiovascular reactivity, which can affect the development and exacerbation of coronary artery disease (Manuck 1994). The chronic stress can lead to repeated reactivity injury inside the coronary arteries, which triggers the plaque-forming process. For cardiovascular patients, the stress increases blood pressure reactivity, which may lead to a “silent killer”: myocardial ischemia (Krantz et al. 1991).

There is a lot of evidence showing that stress contributes to the onset and seriousness of heart disease (Cooper 1983; Krantz et al. 1991), infectious diseases (Cohen and Williamson 1991), diabetes (Grant et al. 1974), cancer (Bammer and Newberry 1981; Cooper 1984), complications in pregnancy (Norbeck and Tilden 1983), and mental health (Avison and Gotlib 1994; Cockerham 2006; Drentea and Lavrakas 2000; Wade and Pevalin 2004). Regarding health in general, McFarlane and his colleagues (1983) find exposure to undesirable and uncontrollable events lead to distress, which in turn, causes
health to deteriorate. In this study, I choose depression as the stress outcome, and relate it to the health indicators.

There are reservations about the use of depression symptoms among Chinese. First, the expression of depression is traditionally suppressed in Chinese society because it associates with the stigma of mental disorder. Second, Chinese traditional medical thoughts and culture tend to link psychological symptoms to physical elements and make them difficult to describe problems in psychological terms (Lin, Kleinman, and Tsung-Yi 1981). However, the concept of depression may vary in different cultures, but the overwhelming evidence supports that even with difference in beliefs, norms, and experiences, the depression does reflect a similar phenomenon of human distress across cultures (Kleinman 1986). After almost one hundred years of industrialization and modernization, the western concept of depression was wildly accepted by Chinese medical, public health, and social science field. The empirical studies of depression in Hong Kong, Taiwan, mainland of China, and Chinese immigrants in other countries have found evidence justifying the use of depression concept among Chinese (Hwang et al. 2007; Kuo and Tsai 1986; Lai 1995; Lee 1981; Lin 1989). The instrument of measuring depression also presents high validity and reliability in different Chinese populations (see details in Chapter 3).

Social Integration and Health

The studies of the association between social integration and health have mushroomed during the last two decades. As a result, social integration has become one of the most important sociological inputs into theoretical frameworks for the explanation
of differences in health and illness between social groups. Although social integration has several loosely interchangeable terms, in general it indicates the extent to which individuals are socially linked to one another (Hartwell and Benson 2007).

The concept of social integration can be dated back to Durkheim (1951), who makes it clear that the social integration is linked to suicide in his classic, *Suicide, a Study in Sociology*. Durkheim differentiates between four types of suicide: the first, egoistic suicide, is more likely to happen in those societies or groups in which the individuals are lacking social integration to a larger social unit. Durkheim suggests an integrated society provides us with our morality, values, sense of purpose, and feeling of moral support to help us through the daily small troubles and frustrations. Persons who are weakly integrated into the society are liable to commit suicide even at a very trivial disappointment (Ritzer and Goodman 2004). The second, anomic suicide, is most likely to occur when there is weak social regulation between the society’s norms and the individual due to rapid social change or major social upheavals. The third and fourth types, altruistic and fatalistic suicide, are the opposite to egoistic and anomic suicide respectively. They are most likely to happen when social integration and regulation on the individual is excessive. In particular, Durkheim emphasizes egoistic and anomic suicide which he believes are a result of weak social regulation and integration in a rapidly changing modern society. In addition to his work on suicide, Durkheim’s position on social integration is also found in *The Division of Labor in Society* (Durkheim 1933), where he discusses the importance of social integration and how social integration is possible when people become more individualistic in modern society. He argues that while “mechanical solidarity” provides social integration in simple societies, “organic
solidarity” provides social integration in complex ones. However, anomie of modern
society resulting from excessive division of labor, according to Durkheim, leads to
isolation and weak social integration (Ritzer and Goodman 2004). In brief, Durkheim
argues that “Suicide varies inversely with the degree of integration of the social groups of
which the individual forms a part” (Durkheim 1951:223) and social disintegration causes
“currents of depression and disillusionment” (Durkheim 1951:214). Following
Durkheim’s logic, researchers develop two basic models to explain how social integration
contribute to health through stress: stress prevention model and stress buffering model
(Uchino 2004). The stress prevention model proposes that if a person is well integrated
into a social network, he can get resources from the network to avoid or reduce his
exposure to stressful events (Gore 1985; LaRocco, House, and French 1980; Russell and
Cutrona 1991). The stress buffering model suggests that social integration decreases the
negative effects of stress on health outcomes and facilitates personal coping ability to
distress (Cohen and Herbert 1996; Cohen and Wills 1985; Cutrona and Russell 1990).

Symbolic interactionism also contributes to the theoretical foundations of social
integration’s effect on health. It highlights how people present and construct their identity,
and how they assess situations in action and interaction. From this theoretical perspective,
human beings form identity in the context of meaningful social ties and roles (Stryker and
Burke 2000). Thoits (1983) suggests that social integration is health protective because
being imbedded in a social network gives individuals meaningful roles and sense of
identity that provide esteem, purpose to life, and normal personal behavior, which in turn
can help prevent anxiety, depression, and disordered behavior. Stroebe and Stroebe (1996)
further suggest that being imbedded in social networks also provides a sense of both
physical and emotional security. Although early role theorists believe that role conflicts and overloaded social roles can lead to negative consequences, current social identity researchers argue that the benefits of social integration through multiple roles overweighs the negative effects of role conflicts (Thoits 2003). There are two hypotheses related with this theoretical perspective: the loneliness hypothesis and social control hypothesis.

Stroebe and his colleagues (Stroebe and Stroebe 1996; Stroebe et al. 1996) propose that loneliness may be an important pathway linking social integration to health outcomes. Some studies find that loneliness affects health negatively through higher stress appraisals, sleep dysfunction, and cardiovascular activation (Cacioppo et al. 2002; Hawkley et al. 2003). However, loneliness may have different aspects. Weiss (1974) distinguishes between social and emotional loneliness. The former originates from the absence of engaging social interactions with others such as neighbors or colleagues, while the latter is caused by the absence of close attachment relationships with others like spouse or close friends. Stroebe and Stroebe (1996) use this framework in their loneliness and psychological well-being research. Green and his colleagues (2001) also demonstrate an association between specific social integration measures and different types of loneliness.

Some researchers (Lewis and Rook 1999; Umberson 1987) introduce the social control hypothesis, which suggests that social integration is health promoting because they facilitate such healthier behaviors as exercise, healthy eating, and not smoking. They argue that multiple social roles provide us with important reasons to live a healthy life, and our social relationship can help us to act in healthy ways. For instance, spouses can remind each other to have a healthy life schedule, drink properly, and exercise regularly.
Especially, after a family has a baby, both parents will pay more attention to healthy behavior for their child. A typical example is many parents quit smoking, using drugs or drinking heavily simply because they want a healthy baby or intend to create a healthy environment for their children’s growth. Lewis and Rook (1999), and Umberson (1987) also provide empirical evidence showing social integration is associated with healthier behaviors and lower risk taking.

There is abundant empirical evidence supporting the association between social integration and health. In a review article published in *Science* (House, Landis, and Umberson 1988), results from prospective studies, in which baseline health status is controlled, consistently show the negative relationship between increased risk of death and the low quantity or low quality of social relationships. Evidence from experimental and quasi-experimental studies of humans and animals also suggest that social integration has an independent protective effect for health outcome from widely varying causes. In public health field, researchers provide evidence in linking social integration to overall mortality since 1970s (Berkman and Syme 1979; Brummett et al. 2001; Dalgard and Lund Haheim 1998; House, Robbins, and Metzner 1982). For example, in Sweden, a 6-year follow-up study demonstrates that social integration is negatively associated with overall mortality controlling for age, gender, education, employment status, smoking, and exercise habits (Orth-Gomér and Johnson 1987).

**Socio-economic Status and Health**

The association between low socio-economic status (SES) and poor health has remained remarkably persistent in most studies conducted for over a century (Davey
Smith et al. 1996; Kitagawa and Hauser 1973; Lahelma et al. 2004; Link and Phelan 2000; Marmot et al. 1997; Mirowsky, Ross, and Reynolds 2000; Phelan et al. 2004). Research also shows the association to be consistent across historical periods for a wide range of illnesses and points in the life course (Davey Smith et al. 1997; House, Kessler, and Herzog 1990; House et al. 1994; Link and Phelan 1995; Williams 1990). Based on the persistent evidence for association between SES and health, some scholars argue that SES is a “fundamental cause” of mortality (Link and Phelan 1995; 2000; Phelan et al. 2004).

Although SES can be measured by occupation, income, wealth, and education, these interrelated measures indicate different dimensions of particular structural locations within a society (Cockerham 2007; Lynch and Kaplan 2000). These structural positions are powerful determinants of the likelihood of health damaging exposures and of possessing particular health enhancing resources, which show a gradient with health (Adler et al. 1994; Lahelma et al. 2004). Efforts to explain the relationship between SES and health most often take one of three rationales: genetic explanation, social selection, and social causation.

Genetic explanation holds that genetic inheritance influences both SES and health (Blane, Smith, and Bartley 1993; Mackenbach 2005). However, studies of twins have shown that genetics alone is not sufficient to account for health (Conley et al. 2003; Karno and Norquist 1995). Consequently, scholars conclude that social and psychological factors are also important predictors for health besides genetic mechanisms (Conley et al. 2003; Freese and Powell 2003; Horwitz et al. 2003; Moldin and Gottesman 1995).

Social selection explanation suggests that there is no causal link from SES to
health and it is health that determines SES (Blane et al. 1993; Cockerham 2006). Two hypotheses of this perspective have been proposed: the drift hypothesis and residue hypothesis. The former maintains that unhealthy persons are more likely to “drift” downward in the social structure, while the latter suggests healthy persons are more likely to be upwardly mobile and leaving the unhealthy “residue” behind. Although there is some evidence supporting the social selection explanation (Dohrenwend 1975; Eaton and Muntaner 1999), this perspective in itself can not fully explain the relationship between SES and health (Cockerham 2006; Fox 1990).

The social causation explanation is the dominant perspective in sociological research (Haas 2006), and considerable evidence is on this side (Fox 1990; Link and Phelan 1995; Turner and Lloyd 1995). This perspective focuses on how SES affects specific social risk factors, which in turn lead to poor health. One of the most important mechanisms is the stress process, which maintains that the lower class is characterized as being subjected to greater adversity and stress as a result of a deprived life situation, less control over their own life, and fewer resources available to cope with stressful situation (Adler et al. 1994; Cockerham 2006; Evans, Barer, and Marmor 1994; Turner and Lloyd 1999). Furthermore, stress affects the emotional ability of the lower class more severely than it does the upper class (Fiscella and Franks 1997; Grzywacz et al. 2004; Turner and Lloyd 1999). Even in adolescents, perceived socioeconomic status is significantly associated with stress (Goodman et al. 2005). Based on numerous studies of both humans and primates, Evans and his colleagues (Evans et al. 1994) argue that stress is the principal cause of the social gradient in mortality: the higher one’s SES, the better one deals with stressful situations and the less severe effects of stress on health. The gradient
decreases proportionally with one’s socioeconomic status going down.

Community Material Resources and Health

Research emphasizing the effect of community context on population health has increased dramatically in the past ten years (Boardman 2004; Cockerham 2007; Sampson, Morenoff, and Gannon-Rowley 2002). Several community characteristics attract researchers’ attention for their impact on individual’s health: neighborhood disadvantage and disorder (Geis and Ross 1998; Ross 2000; Ross and Mirowsky 2001), neighborhood housing quality (Kahlmeier et al. 2001), objective and perceived neighborhood environment (Latkin and Curry 2003; Stiffman et al. 1999; Wen, Hawkley, and Cacioppo 2006), residential stability (Boardman 2004; Ross, Reynolds, and Geis 2000), social integration and cohesion (Aneshensel and Sucoff 1996; Elliott 2000).

However, since most of these studies are based on cross-sectional data, the support that there is causal linkage between community context and health is inconclusive. Furthermore, the fact that it requires a relatively long period to identify the community change adds to the difficulty to examine its effects. As a result, the endogeneity problem, whether community context causes different health outcomes or the health status of individual persons direct them to choose different communities, cannot be addressed effectively and has therefore weakened the suggestion about the causal role of community context (Duncan and Raudenbush 1999; Sampson et al. 2002; Winship and Morgan 1999). Fortunately, the Dam Project provides us a unique opportunity to conquer the obstacle by the possibility of designing a natural experimental research.
One of the important reasons for community context contributing to the physical and mental health of a population is the availability of valuable community resources (Keita 2007). According to Fitzpatrick and LaGory (2000), our place of residence include both risks and protective resources. A disadvantaged community will have fewer resources like good schools, parks, and services, which may lead to chronic stress (LaGrange, Ferraro, and Supancic 1992; LeClere, Rogers, and Peters 1997; Robert 1998; Taylor and Hale 1986; Wilson 1987). On the other hand, some scholars (Aneshensel and Sucoff 1996; Steptoe and Feldman 2001) provide substantial evidence that lack of public facilities and decay of infrastructure are positively related to psychological distress.

Disadvantaged communities may also affect people’s health through higher food prices and less selection of healthy foods like fresh fruits and vegetables because of constraints to convenient shopping access (Morland et al. 2002a; Morland, Wing, and Roux 2002b). Finally, communities vary in the amount of health service resources. Disadvantaged communities have fewer health services, and the access of health care is limited, which will affect the residents’ health negatively (Kirby and Kaneda 2005; Ross and Wu 1995).

Research Model and Hypotheses

My conceptual model (Figure 2) suggests that the vulnerability of migrants is a result of a combination of several factors. Because the displacement is expected to affect migrants’ social integration, SES, and their community material resources, I expect a significant difference between TGDP migrants and their non-moving counterparts in their psychological distress and health. It is hypothesized that the TGDP-induced displacement causes secondary stressors, which in turn negatively affect migrants’ health. In other
words, the TGDP displacement affects mental and physical health not only directly, but also indirectly through the secondary stressors:

Hypothesis 1: A development-induced displacement leads to secondary stressors such as decreased social integration (path a), worsened socioeconomic status (path b), and fewer community material resources (path c).

Hypothesis 2: These secondary stressors heighten depression (path d, e, f).

Hypothesis 3: The heightened depression leads to poorer health outcomes (path l).

Hypothesis 4: These secondary stressors affect health outcomes directly (path g, h, i).

Hypothesis 5: The displacement heightens the depression directly (path j).

Hypothesis 6: The displacement affects health outcomes directly (path k).

Hypothesis 7: The displacement affects the depression and health outcomes indirectly through secondary stressors
Figure 2. Research Model for the Displacement and Health
CHAPTER 3
RESEARCH DESIGN

Data

Due to the practical difficulties to anticipate and design a prospective migration study, past research of migration and health has suffered from three methodological difficulties: first, it has relied on ex post facto research designs, the accuracy of retrospective measures is challenged because of faulty memories and post-factum rationalizations (Campbell and Stanley 1966). Second, it is difficult to find a suitable comparison group either from the sending or the receiving communities. Third, the selective nature of migration challenges a causal explanation of migration effects (Borjas 1987; Jasso and Rosenzweig 1990). Without controlling for pre-migration baseline, it is problematic for researchers to attribute any observed post-migration differences to “migration effects” (Lieberson 1985). As a result, past claims about the link between migration and health are cast into doubt (Conley et al. 2003; Landale and Oropesa 2001). However, the Dam Project provides an ideal research condition to overcome these challenges and makes a quasi-experimental design possible. The construction of the dam and the reservoir requires the relocation of all those who are in the way on a non-selective basis. This allows us to rule out selectivity as an extraneous factor and to measure migration effects free of the confounding effect. In addition, the Dam Project as a well-planned process permits us to conduct pre- and post-migration surveys rather than having to rely exclusively on retrospective measures to assess migration consequences. Finally,
we include non-migrants from the same region as controls.

Our design consisted of one pre-migration and one post-migration survey for both migrants (the study group) and non-migrants (the control group). In late 2002 and early 2003, 975 designated migrants and 555 non-migrants were recruited from the Wanxian Relocation and Development Region (WRDR), where 80% of designated migrants resided (Weng 1999). Sampling was done in two stages: first, the study population in the WRDR was stratified by rural/urban residence and randomly selected three rural and two urban communities (clusters); next, a systematic sample was taken from each of the two larger communities and a census was taken in each of the three small ones to select households. Face-to-face interviews were conducted with a household member aged 15 years or older from the selected households by graduate students major in sociology from two Chinese Universities. We selected both migrants and non-migrants from the same community to make sure that the control group had characteristics comparable to the study group. The response rate was 99%, which is considered extremely high in standards familiar to U.S. researchers, but it is common for face-to-face interviews in China (Feng 2007; Wang 1996).¹

Table 2 is adapted from Xi (2007), comparing the demographic profile of the pre-migration sampled households with the WRDR 2000 census. The results indicated that the sample was not substantially different from the population in terms of gender, age, education attainment, and average family size.
Table 2. Demographic Profile of Household Sample and Census 2000 for WRDR

<table>
<thead>
<tr>
<th></th>
<th>Census 2000</th>
<th>TGDP Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>51.92</td>
<td>50.00</td>
</tr>
<tr>
<td>Female</td>
<td>48.08</td>
<td>50.00</td>
</tr>
<tr>
<td>Age (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-14</td>
<td>21.84</td>
<td>15.23</td>
</tr>
<tr>
<td>15-64</td>
<td>70.15</td>
<td>75.27</td>
</tr>
<tr>
<td>65+</td>
<td>8.01</td>
<td>9.50</td>
</tr>
<tr>
<td>Education (^a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>primary school</td>
<td>43.36</td>
<td>40.85</td>
</tr>
<tr>
<td>middle school</td>
<td>29.47</td>
<td>32.87</td>
</tr>
<tr>
<td>highschool</td>
<td>8.6</td>
<td>14.25</td>
</tr>
<tr>
<td>college+</td>
<td>2.82</td>
<td>12.03</td>
</tr>
<tr>
<td>Residence (^b)(%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>66.91</td>
<td>52.00</td>
</tr>
<tr>
<td>Urban</td>
<td>33.09</td>
<td>48.00</td>
</tr>
<tr>
<td>Family size</td>
<td>3.23</td>
<td>3.87</td>
</tr>
</tbody>
</table>

\(^a\) Census 2000 education is measured as "Population with various education attainment per 100,000 population". The sum of it is not the total population.

\(^b\) Rural residents number for the family sample is calculated by the number of rural family number times the mean size of rural family.

Source: Xi (2007).
We successfully traced and re-interviewed 1070 subjects in the follow-up survey conducted in early 2006, with a success rate of 70%. Among them, 350 respondents were non-migrants, 286 were designated migrants but hadn’t moved, and 434 were designated migrants who had moved. The final sample size used in the analysis is 1056 after deleting 14 unqualified subjects. While the recapture rate is respectable given the highly mobile nature of the population being studied, an attrition of 30% inevitably raises concerns about whether the study might be biased by the attrition. We conducted a sensitivity analysis to address possible biases that might result from the attrition by using six factors as predictors of attrition: migration status, gender, residence, age, education, and household income. Table 3 indicated that only two of these factors (i.e., migration status and urban/rural residence) had a significant effect on the attrition, with migrants and urban residents being more likely to be missed in the follow-up survey.

We will address the attrition problem further in the analysis by adding an attrition correction factor into my model. Using the attrition equation presented in Table 3, the attrition correction factor was computed as the predicted probability that a respondent captured in wave 1 was lost in wave 2, minus 1 (Berk 1983). The addition of the attrition correction factor into the model minimizes the possibility of potential biases resulting from non-random loss of respondents in the follow-up survey (Heckman 1979).
Table 3. Attrition Equation for Missed Cases\(^a\) (n=1530)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coeff.</th>
<th>t-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Migration Status (Migrant=1)</td>
<td>0.07</td>
<td>* 2.78</td>
</tr>
<tr>
<td>Gender (Female=1)</td>
<td>0.02</td>
<td>NS 0.99</td>
</tr>
<tr>
<td>Residence (Rural=1)</td>
<td>-0.11</td>
<td>* -4.30</td>
</tr>
<tr>
<td>Age</td>
<td>0.00</td>
<td>NS 1.29</td>
</tr>
<tr>
<td>Education</td>
<td>0.00</td>
<td>NS 0.15</td>
</tr>
<tr>
<td>House income (in ten thousand)</td>
<td>0.01</td>
<td>NS 1.88</td>
</tr>
</tbody>
</table>

\(^a\) 0=success in follow-up, 1=missing in follow-up

* p< .05, NS: Not Significant.

Analytical Strategy

To find out whether the dam project leads to secondary stressors and group difference in the change of depression and health, I use the “difference model” (Allison 1994; Allison 1990; Halaby 2004; Liker, Augustyniak, and Duncan 1985) to analyze the panel data. Mathematically, the difference model is a strategy for analyzing changes based on two adequately specified cross-sectional equations, one for time 1 and the other for time 2, as indicated by the subscripts (Halaby 2004):

\[
Y_{i1} = \alpha_1 + \gamma_1W_{i1} + \beta_1Z_i + \epsilon_{i1}
\]

\[
Y_{i2} = \alpha_2 + \delta X_i + \gamma_2W_{i2} + \beta_2Z_i + \epsilon_{i2}
\]  \hspace{1cm} (1)

While the Z in the equations refers to a vector of time-invariant explanatory variables, the W represents a vector of explanatory variables that vary with time. The \(\gamma\) and \(\beta\) are vectors of coefficients associated with W and Z, respectively. The X in the equation for time 2 is migration status and the \(\delta\) measures the effect of the displacement,
which is the effect of my principal interest. When subtracting equation for time 1 from that for time 2, we can obtain the following equation:

\[ Y_{i2} - Y_{i1} = (\alpha_2 - \alpha_1) + \delta X_i + (\gamma_2 W_{i2} - \gamma_1 W_{i1}) + (\beta_2 Z_i - \beta_1 Z_i) - (\varepsilon_{i2} - \varepsilon_{i1}) \]  

(2)

Equation (2) can be simplified when two assumptions are introduced. First, \( \beta_1 = \beta_2 \), implying that the effects of time-invariant independent variables \( Z \) are identical in wave 1 and wave 2 (Allison 1990). Second, \( \gamma_1 = \gamma_2 = \gamma \), suggests that although \( W \) may change from one time to the next, its effect on \( Y \) is stable overtime especially when the time interval is short (Halaby 2004). With these assumptions, equation (2) can be reduced to equation (3):

\[ Y_{i2} - Y_{i1} = (\alpha_2 - \alpha_1) + \delta X_i + \gamma (W_{i2} - W_{i1}) + (\varepsilon_{i2} - \varepsilon_{i1}) \]  

(3)

Equation (3) makes clear that the difference in \( Y \) between time 1 and time 2 can be explained by migration status (\( X \)) and by the changes in values of time-variant factors (\( W \)) from time 1 to time 2. Thus, efficient estimation of the effect of migration can be accomplished by a single application of OLS without the inclusion of time-invariant factors (\( Z \)). The model acquires its name, *difference model*, because it relates the difference scores for the dependent variables to the difference scores for a set of independent variables. The \( \delta \) in the equation (4), which measures the difference between migrants and non-migrants in the change score of outcome variable, is a *difference-in-differences* (DID) estimator (Allison 1990; Halaby 2004):

\[ \text{DID} = \delta = (\bar{Y}_{M2} - \bar{Y}_{M1}) - (\bar{Y}_{N2} - \bar{Y}_{N1}) \]  

(4)

It quantifies the extent to which the change in outcome between time 1 and time 2 for project-induced migrants (\( M \)) exceeds the corresponding change for non-migrants (\( N \)). In other words, DID score measures the group difference in outcome variables
between migrants and non-migrants after adjusting for the effects of time-invariant (Z) and time-variant (W) factors.

The difference model has two major advantages over other commonly used ones to analyze panel data (Allison 1990; Firebaugh and Beck 1994; Halaby 2004). The first is that unobserved time-invariant exogenous variables (i.e., Z in equation 1) can be omitted from the model. This feature enables researchers to specify models parsimoniously without risking specification errors. Second, the difference model is an effective method for controlling “period effects” (Halaby 2004). Allison (1994) points out that in non-experimental data, the DID estimator is nearly always preferable for estimating the effects of events, or intervention, because it automatically controls for all constant, unobserved differences between individuals, no matter whether or not those differences are associated with the likelihood of event occurrence.

After the difference model certifies that the displacement leads to secondary stressors, and significant impacts on depression and health, I will use Structural Equation Modeling (SEM) procedures to further clarify the direct and indirect links between health and the TGDP-induced displacement. The LISREL 8.80 software system will be used to build a measurement model of latent factors for change to evaluate secondary stressors, and then to test whether secondary stressors and depression mediate the displacement’s effect on health. The advantage of extract latent factors for secondary stressors is to prevent that the measurement error of a single variable bring the potential bias to the analysis (Roth et al. 2005; Shrout and Bolger 2002).

The structural equation modeling proceeds in two steps, based on the method by Anderson and Gerbing (1988). First, I will conduct Confirmatory Factor Analysis (CFA)
to evaluate the fitness of measurement model. Second, I will construct structural regression models to synthesize path and measurement models, and then compare the model fit of structural regression models to identify a parsimonious model. Except for the displacement, all the variables in the SEM models will be change scores. It is approved that SEM method can use change scores to provide sensitive mediation effects test (Judd, Kenny, and McClelland 2001; Roth et al. 2005).

Measures

Outcome Measures

Two outcome variables were examined. The first one was depression, which is commonly used and represents the primary interest of sociological studies of stress (Kessler et al. 1994; Thoits 1995; Turner and Lloyd 1999; Vega and Rumbaut 1991). Depression was measured by self-reported 20-item Center for Epidemiological Studies Depression (CES-D) Scale (Radloff 1977), which measures an individual’s current level of depressive symptomatology. Respondents were asked during the past week how often you have felt 1) Bothered? 2) Everything was an effort? 3) As good as other people? 4) Hard to concentrate? 5) Sad? 6) Fearful? 7) Lonely? 8) Crying spells? 9) Talking less? 10) Restless sleep? 11) Enjoying life? 12) Blues? 13) Failure? 14) Happy? 15) couldn’t get going? 16) Hopeful about the future? 17) People unfriendly? 18) Poor appetite? 19) Depressed? 20) People disliked me? (See the exact wordings of the full questions in Appendix A). All items were coded within a range of 0-3: with 0 for less than once a week, 1 for one to two days a week, 2 for three to four days a week, and 3 for five to seven days a week (items 3, 10, 14, 16 are reversed coded). The scale produces a range of
0-60 summed score, with high score indicated high level of depression.

This instrument has well-established reliability and validity (Ensel and Lin 1991; Pearlin 1989; Radloff 1977). It has been used wildly in different Chinese populations with good reliability and validity, for example, in the adolescent (Ling et al. 2008), in the adults (Liu, Men, and Tang 2004; Xing and Shen 1997), in the urban residents (Zhou et al. 2008), and in the rural residents (Zhang, Kong, and Zhou 2009). In this research, the same scale was used in both pre-migration and post-migration survey. The scale has a reliability of .87 for pre-migration survey and .89 for post-migration survey. The change score in depression is used in analysis, which reflects the difference in the wave 2 and wave 1 measure of CES-D score.

My second outcome variable is Self-Rated Health (SRH), which reflects how respondents rated their health at the time of the interview, using a single item 5-point scale ranging from 1 to 5, with a higher score indicating better status of health. The change in SRH is the difference score between wave 1 and 2.

There are four reasons to use SRH as the health outcome measurement: First, it is the most widely used measurement of health in population surveys (Idler and Benyamini 1997). Second, although some research suggests that it is a conservative measure of health (George and Bearon 1980; Maddox 1962; Maddox 1964), it is generally regarded as reliable and valid in survey research (Farmer and Ferraro 1997; Hays et al. 1996; Idler and Benyamini 1997; Johnson and Wolinsky 1993; Lynch 2003). Third, it can be used for different race and ethnic groups. An epidemiological study of a multiethnic sample in the United States shows a strong association between SRH and mortality across different race and ethnic groups (McGee et al. 1999).
Measures of Primary Stressor and Secondary Stressors

The primary stressor was measured by migration status, a dummy variable which differentiates migrants (coded 1) from non-migrants (coded 0). In this study, migrants refer to the 420 designated migrants (40% of the sample) who had actually moved. Designated migrants who had not moved are treated as non-migrants, because they didn’t experience the actual migration process. I had three secondary stressors: changes in social integration, changes in socioeconomic status, and changes in community material resources.

Three indicators are used to measure changes in social integration: change scores of social support, social network size, and rapport with neighbors. Social support is measured by perceived routine support scale (Lin, Ye, and Ensel 1999), which quantifies the instrumental and emotional support the respondent perceives that s/he is able to obtain from her/his own social network. The scale asked respondents whether they could get help in the following areas if they needed it: 1) Loan? 2) Doing things around the house? 3) A ride to someplace? 4) Daily routine? 5) Watching house? 6) Talk about things bothering? 7) Company? 8) Talking about family arguments? 9) Making feel good, loved, or cared for? 10) Talking about disappointments? (See the exact wordings of the full questions in Appendix B). Responses were coded 1 for “No,” 2 for “Don’t know,” 3 for “Yes, with difficulty,” and 4 for “Yes.” Responses were summed to produces an index of perceived routine support scored 10 to 40, with high score indicating high-perceived routine support. The scale is reliable with a Cronbach’s alpha of 0.83 in wave 1 and 0.88 in wave 2. Social network size was measured by asking the respondents whether or not they have interacted with any of the following individuals with whom they do not share a
residence during the past 30 days: (1) parents; (2) adult children; (3) siblings; (4) other relatives; (5) good friends; (6) neighbors; (7) colleagues; (8) local cadres; and (9) other significant others? The sum of the 9 items yielded a count measure, ranging from 0 to 9.

*Rapport with neighbors* was measured by asking respondents, “In general, how would you describe your relationship with your neighbors?” It is a 5-point scale ranging from 1 to 5, 1 for “Very bad,” 2 for “bad,” 3 for “Just so-so,” 4 for “good,” and 5 for “very good.” All the change scores are the difference between wave 2 and wave 1 measures.

*Socioeconomic status change*, my next secondary stressor, was also measured by the change scores of three indicators: household income per capita, household debt per capita, and possession of necessities. *The household income per capita* equaled last year household income divided by the number of household members. *The household debt per capita* was current household debt divided by the number of household members. I measured *the household possession of necessities* by the sum of following household necessities: a washing machine, an air conditioning unit, a motorcycle, a computer, or a refrigerator—things that reflect a better economic condition in China.

I measured *community material resources* by asking respondents how convenient it is for them to do the following things in their current place of residence: (a) seeing doctors, (b) sending children to school, (c) shopping, and (d) entertainment. Answers were coded 1 for “Very inconvenient,” 2 for “Inconvenient,” 3 for “Hard to say,” 4 for “Convenient,” and 5 for “Very convenient.” Responses to the four questions were summed to form a scale, ranging from 4 to 20, with a higher score indicating greater community resources. The scale had a Cronbach’s $\alpha$ of 0.81 for wave 1 and 0.85 for wave 2. *The change in community material resources*, the third secondary stressor, is the
difference score between wave 1 and wave 2 measures.
CHAPTER 4

RESULTS

Descriptive Analysis

This chapter presents the results of analyses based on a sample of 1056 respondents. It is helpful to explore the descriptive statistics and bivariate associations of variables of interest before presenting the results of the difference model and structural equation model. Table 4 shows the bivariate associations among all endogenous focal variables as well as their means and standard deviations. They are all measured as change scores: the difference between wave 2 and wave 1 measures.

During the three years period, CES-D has increased by an average of 2.21 points, and self-rated health decreased by an average of 0.19 points for all the respondents. The mean change of social support increases by 0.16 points, while average social network size change decreases by 0.14 points, and average change in rapport with neighbors decreases by 0.06 points. Per capita household income and possession of household necessities have an increase of 769.79 yuan (around 110 U. S. dollar) and 0.26 points annually, but the per capita household debt also increases by 1502.36 yuan (around 220 U. S. dollar). There are noticeable declines in three community resources, such as medical resources by 0.11 points, education resources by 0.09 points, and shopping resources 0.13 points. However, the entertainment resources increase by 0.24 points. Due to the unreliability of change scores, all the standard deviations of change scores are high (Allison 1990; Kessler 1977).
Table 4. Means, Deviations, and Bi-variate Correlations for Variables of Interest (n=1,056)

<table>
<thead>
<tr>
<th>Variable</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ CES-D</td>
<td>-0.28 †</td>
<td>-0.16 †</td>
<td>-0.07 **</td>
<td>-0.07 **</td>
<td>-0.03</td>
<td>0.08 **</td>
<td>-0.10 †</td>
<td>-0.13 †</td>
<td>-0.12 †</td>
<td>-0.14 †</td>
<td>-0.05 *</td>
<td>2.21</td>
<td>11.00</td>
</tr>
<tr>
<td>Δ Health</td>
<td>0.08 **</td>
<td>0.08 †</td>
<td>0.05 *</td>
<td>0.10 †</td>
<td>-0.03</td>
<td>0.08 †</td>
<td>0.09 †</td>
<td>0.07 **</td>
<td>0.08 †</td>
<td>0.08 †</td>
<td>-0.19</td>
<td>1.11</td>
<td></td>
</tr>
<tr>
<td>Δ Social Support</td>
<td>0.10 †</td>
<td>0.07 **</td>
<td>0.02</td>
<td>-0.06 **</td>
<td>0.04</td>
<td>0.08 **</td>
<td>0.13 †</td>
<td>0.10 †</td>
<td>0.11 †</td>
<td>0.16</td>
<td>8.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ Social Network Size</td>
<td>0.14 †</td>
<td>0.04</td>
<td>-0.08 †</td>
<td>0.08 **</td>
<td>0.04</td>
<td>0.08 **</td>
<td>0.04</td>
<td>0.03</td>
<td>-0.14</td>
<td>1.84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ Rapport with Neighbors</td>
<td>0.00</td>
<td>-0.04</td>
<td>0.05</td>
<td>0.11 †</td>
<td>0.13 †</td>
<td>0.10 †</td>
<td>0.05</td>
<td>-0.08</td>
<td>0.93</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ Per Capita Income</td>
<td>0.09 †</td>
<td>0.18 †</td>
<td>0.00</td>
<td>-0.04</td>
<td>-0.02</td>
<td>-0.01</td>
<td>769.79</td>
<td>5366.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ Per Capita Debt</td>
<td>-0.10 †</td>
<td>-0.05 †</td>
<td>-0.03</td>
<td>-0.02</td>
<td>-0.01</td>
<td></td>
<td>1602.36</td>
<td>6341.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ Possession of Necessities</td>
<td>0.11 †</td>
<td>0.05</td>
<td>0.03</td>
<td>0.02</td>
<td></td>
<td></td>
<td>0.26</td>
<td>0.96</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ Medical Resources</td>
<td>0.56 †</td>
<td>0.65 †</td>
<td>0.37 †</td>
<td>-0.11</td>
<td></td>
<td></td>
<td></td>
<td>1.33</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ Education Resources</td>
<td>0.58 †</td>
<td>0.39 †</td>
<td>-0.09</td>
<td>1.57</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ Shopping Resources</td>
<td>0.43 †</td>
<td>-0.13</td>
<td>1.32</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ Entertainment Resources</td>
<td>0.24</td>
<td>1.75</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Indicates a coefficient is significant at the .10 level.
** Indicates a coefficient is significant at the .05 level.
† Indicates a coefficient is significant at the .01 level.
The first row indicates an increase in CES-D is associated with an increase in household debt. On the other hand, a decrease in CES-D is associated significantly with increases in self-rated health, social support, social network size, possession of household necessities, medical resources, education resources, shopping resources, and entertainment resources. Although change in per capita household income correlates negatively with change in CES-D, it is not significant.

The second row shows that change in self-rated health is related positively with change in social support, social network size, rapport with neighbors, household income, possession of household necessities, medical resources, education resources, shopping resources, and entertainment resources. The association between self-rated health and household debt is not significant. For the rest of correlation matrix, the only unexpected pattern is the significant positive relation between household income and debt. The pattern, however, may indicate that people are more willing to loan money to those who have the ability to repay than those who do not.

The bivariate correlation provides tentative support to the expected associations between the outcome of interest and secondary stressors. However, these associations do not provide a rigid test of the causal hypothesis as many factors correlated with both the independent and dependent variables were not taken into consideration.

**Difference Model**

Table 5 presents the averages of the ten independent variables and two dependent variables measured in time 1 (\( \bar{Y}_1 \)) and time 2 (\( \bar{Y}_2 \)) separately for migrants and non-migrants. It also reports the differences between the two averages and the
unadjusted and adjusted DID scores. The unadjusted DID scores are computed based on equation (4) mentioned in chapter 3:

$$DID = \delta = (\bar{Y}_{M2} - \bar{Y}_{M1}) - (\bar{Y}_{N2} - \bar{Y}_{N1})$$

To get the adjusted DID scores, I control for the attrition correction factor in the difference model.

The first group of indicators is social integration. The results show that migrants experience a decline in perceived routine social support by 0.68 points during the 3 years period, while non-migrants see an increase of 0.66 points, which results in a significant relative loss in social support (DID = -0.68-0.66= -1.34). Although both migrants and non-migrants’ social network sizes diminish, the migrants suffer a significantly greater loss (DID = -0.21). The rapport with neighbors is also in decline for migrants (-0.21), but a slight rise for non-migrants (0.03), which leads to a significantly greater loss for migrants (DID = -0.25).
Table 5. DID Scores Measuring the Displacement’s Impacts (n=1,056)

<table>
<thead>
<tr>
<th>Social Integration</th>
<th>( \bar{Y}_1 )</th>
<th>( \bar{Y}_2 )</th>
<th>Differences</th>
<th>Unadjusted DID</th>
<th>Adjusted DID*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Routine Social Support (13 items)</td>
<td>Migrant 33.00</td>
<td>Non-migrant 34.72</td>
<td>-0.66</td>
<td>-1.34 **</td>
<td>-1.20 **</td>
</tr>
<tr>
<td>Social Network Size (0–5)</td>
<td>Migrant 3.55</td>
<td>Non-migrant 3.80</td>
<td>-0.26</td>
<td>-0.21 *</td>
<td>-0.18</td>
</tr>
<tr>
<td>Rapport with Neighbors (1–5)</td>
<td>Migrant 4.10</td>
<td>Non-migrant 4.00</td>
<td>-0.21</td>
<td>-0.25 †</td>
<td>-0.24 †</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social Economic Status</th>
<th>( \bar{Y}_1 )</th>
<th>( \bar{Y}_2 )</th>
<th>Differences</th>
<th>Unadjusted DID</th>
<th>Adjusted DID†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Capita Income ($)</td>
<td>Migrant 3186.16</td>
<td>Non-migrant 2790.73</td>
<td>240.01</td>
<td>-907.51 †</td>
<td>-899.87 †</td>
</tr>
<tr>
<td>Per Capita Debt ($)</td>
<td>Migrant 1033.74</td>
<td>Non-migrant 817.41</td>
<td>2372.45</td>
<td>1444.68 †</td>
<td>1249.50 †</td>
</tr>
<tr>
<td>Possession of Household Necessities (0–5)</td>
<td>Migrant 0.64</td>
<td>Non-migrant 1.24</td>
<td>0.11</td>
<td>0.08</td>
<td>0.07</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Community Material Resources</th>
<th>( \bar{Y}_1 )</th>
<th>( \bar{Y}_2 )</th>
<th>Differences</th>
<th>Unadjusted DID</th>
<th>Adjusted DID†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Resources (1–5)</td>
<td>Migrant 4.25</td>
<td>Non-migrant 4.47</td>
<td>-0.18</td>
<td>-0.11</td>
<td>-0.10</td>
</tr>
<tr>
<td>Education Resources (1–5)</td>
<td>Migrant 3.67</td>
<td>Non-migrant 4.18</td>
<td>-0.29</td>
<td>-0.32 †</td>
<td>-0.30 †</td>
</tr>
<tr>
<td>Shopping Resources (1–5)</td>
<td>Migrant 4.24</td>
<td>Non-migrant 4.40</td>
<td>-0.14</td>
<td>-0.18 **</td>
<td>-0.18 **</td>
</tr>
<tr>
<td>Entertainment Resources (1–5)</td>
<td>Migrant 3.73</td>
<td>Non-migrant 3.65</td>
<td>0.19</td>
<td>-0.08</td>
<td>-0.03</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome</th>
<th>( \bar{Y}_1 )</th>
<th>( \bar{Y}_2 )</th>
<th>Differences</th>
<th>Unadjusted DID</th>
<th>Adjusted DID†</th>
</tr>
</thead>
<tbody>
<tr>
<td>CES-D (20 items)</td>
<td>Migrant 21.65</td>
<td>Non-migrant 20.62</td>
<td>4.31</td>
<td>3.49 †</td>
<td>3.72 †</td>
</tr>
<tr>
<td>Self-Rated Health (1–5)</td>
<td>Migrant 3.48</td>
<td>Non-migrant 3.53</td>
<td>-0.29</td>
<td>-0.18 †</td>
<td>-0.20 †</td>
</tr>
</tbody>
</table>

* Controlling for attrition correction factor.
† Indicates a coefficient is significant at the .10 level.
** Indicates a coefficient is significant at the .05 level.
*** Indicates a coefficient is significant at the .01 level.

My findings indicate that migrants and non-migrants both enjoy some increases in per capita income, but the increase for non-migrants is much larger (240 yuan vs. 1147 yuan). It leads to a relative “loss” of 907.51 for migrants (DID = -907.51). This finding clearly demonstrates the value of a control group in controlling for income increase resulting from social changes. On average, migrants have seen an increase in debts per capita that was 1444.68 yuan more than non-migrant counterpart (DID =1444.68). The social-economic impacts of the project is also measured by the change of standard of
living, which is indicated in this study by the possession of household necessities such as washing machine, air conditioning unit, motorcycle, computer, and refrigerator. Because they are expensive durable goods for common Chinese families, the possession of such items can reflect people’s living standard. Both migrants and non-migrants have experienced an upturn in the household necessities, and migrants increased slightly faster than non-migrants (DID =0.08). However, this advantage for migrants was not statistically significant. The results show that the social-economic wellbeing of migrants, as indicated by their income and debts suffered a significant blow by the displacement.

The next group of indicators of secondary stressors I will examine is changes in community material resources. I find that migrants have suffered a relative deterioration in all the indicators of community resources after the displacement. However, only changes in education resources (DID = -0.32) and shopping resources (DID = -0.18) are statistically significant.

In terms of changes in the two outcome variables, I find that both migrants and non-migrants experience an increase in depression (4.31 vs. 0.82), with the increase of migrants’ CES-D scores being much higher than that of non-migrants (DID =3.49). Migrants also experience a relative significant decline in self-rated health (DID =-0.18).

After controlling for the attrition correction factor, the DID scores don’t change much. Only one DID score, social network size, becomes non-significant. Since the DID scores measure the difference between migrants and non-migrants after controlling for the effects of time-invariant factors, these results provide additional support to my hypotheses that the development-induced displacement leads to a heightened level of depression and deteriorated health by producing secondary stressors such as decreased
social integration, worsened socioeconomic status, and a deterioration of community material resources.

Structural Equation Modeling

The difference model tests the causal link between the displacement and secondary stressors, depression, and health, but the mediation effects of secondary stressors and depression on health are still unexamined. I will turn to Structural Equation Modeling (SEM) procedures to test the mediation effects of three latent factors of secondary stressors and depression.

Following the two-step rule (Bollen 1989; Kline 2005), I first conduct the Confirmatory Factor Analysis (CFA) to assess the fitness of the three-factor measurement model for the secondary stressors. Based on the results in table 5, I include 7 indicators whose DID scores are statistically significant, i.e., change in social support, change in social network, change in rapport with neighbors, change in income per capita, change in debt per capita, change in education resources, and change in shopping resources. Figure 3 shows the measurement model in which the change scores for the 7 indicators load on three correlated latent factors of secondary stressors.
Figure 3. Three Latent Factors Measurement Model of Change (Δ) with the Standardized Solution.
The model has a good fit: $\chi^2=17.95$ (11 degree of freedom), $p =0.08$, RMSEA= 0.02, $p (\text{RMSEA} < 0.05) = 0.991$. However, the standardized loading of debts on the SES latent factor is very low: 0.04. It means that a priori measurement model may not be correct (Kline 2005). I revised the model by dropping the SES latent factor to make a two correlated latent factors measurement model as shown in figure 4. I will use the change of income and debt as two covariates later in the combined model. Model fit was also examined for this two factors measurement model: $\chi^2=4.34$ (4 degree of freedom), $p =0.36$, RMSEA= 0.01, $p (\text{RMSEA} < 0.05) = 0.96$. This model fit the observed data well, with all factor loadings are statistically higher than zero, $p<0.01$. The modification indices check doesn’t suggest possible further model fit improvement. I will use this two factors measurement model in all the subsequent combined SEM models.
* Indicates a coefficient is significant at the .10 level.
** Indicates a coefficient is significant at the .05 level.
† Indicates a coefficient is significant at the .01 level.

Figure 4. Two Latent Factors Measurement Model of Change (Δ) with the Standardized Solution
Next, I construct the structural regression (SR) model (or hybrid model) to combine the path and measurement models by adding the displacement as the predictor of changes in secondary stressors, depression, and health. Besides the two latent factors, changes in income per capita, and debt per capita are also modeled as predictors of depression and health. A full SR model (figure 5) is first evaluated that includes estimated paths from displacement to four correlated secondary stressors: two latent factors, change in income, and change in debts, as well as the direct paths from displacement to changes in depression and health. In addition, all possible paths from secondary stressors to changes in depression and health are estimated. The model fits the data very well: $\chi^2=22.70$ (20 degree of freedom), $p = 0.30$, RMSEA = 0.01, $p$ (RMSEA < 0.05) = 1.00. As expected, the displacement leads to secondary stressors. Especially, it reduces social integration ($\beta=-0.27, p<0.01$), deteriorates community resources ($\beta=-0.11, p<0.01$), reduces income ($\beta=-0.09, p<0.01$), and raises debts ($\beta=0.11, p<0.01$). Displacement also causes an increase in depression ($\beta=0.06, p<0.01$), but does not affect health directly. In addition, an increase in depression has a significant negative impact on health ($\beta=-0.23, p<0.01$). My SEM model indicates that changes in social integration have a negative effect on change in depression ($\beta=-0.26, p<0.01$), but a positive effect on change in health ($\beta=0.14, p<0.10$). Finally, an increase in income is found to associate with an improvement in health ($\beta=0.09, p<0.01$). However, not all paths are statistically significant, including the paths linking debts and community resources to depression and health, as well as the direct effect of displacement on health.
* Indicates a coefficient is significant at the .10 level.
** Indicates a coefficient is significant at the .05 level.
† Indicates a coefficient is significant at the .01 level.

Figure 5. Structural Regression Model of Displacement Effects on Changes in Depression and Health with the Standardized Solution
I modify the model by forcing the 6 non-significant paths to be zero. The model (figure 6) has an excellent fit to the observed data: $\chi^2=23.48$ (26 degree of freedom), $p=0.61$, RMSEA= 0.00, $p$ (RMSEA < 0.05) = 1.00. The difference in $\chi^2$ (0.78, df=5, $p>0.90$) indicates that the modified model doesn’t change model fit significantly, while it meets the parsimony principle. However, the direct path from displacement to depression change is no longer significant after the change in model specification. The reduced model suggests that the impact of the displacement on depression is mainly indirect.

I make the final SR model (figure 7) by trimming the path from displacement to depression change. This final model also fits the data very well: $\chi^2=25.34$ (27 degree of freedom), $p=0.56$, RMSEA=0.00, $p$ (RMSEA < 0.05) = 1.00. The comparison between the final model and modified model in $\chi^2$ (1.86, df=1, $p>0.15$) indicates that the final model achieves the model parsimony one more step without changing the model fit significantly.
Figure 6. Trimmed Structural Regression Model of Displacement Effects on Changes in Depression and Health with the Standardized Solution

* Indicates a coefficient is significant at the .10 level.
** Indicates a coefficient is significant at the .05 level.
† Indicates a coefficient is significant at the .01 level.
* Indicates a coefficient is significant at the .10 level.
** Indicates a coefficient is significant at the .05 level.
† Indicates a coefficient is significant at the .01 level.

Figure 7. Final Structural Regression Model of Displacement Effects on Changes in Depression and Health with the Standardized Solution
As shown in figure 7, the effects of displacement on health are mediated by two secondary stressors: deterioration in social integration and decrease in income. While the displacement affects depression mainly by reducing social integration, its indirect effect on health is mediated both by social integration and income (see table 6 for all the indirect effects).

The total standardized effect of the displacement on health is -0.08 ($\beta=-0.08$, $p<0.01$). The indirect effect of the displacement through income change is -0.01 (-0.09*0.09), while the indirect effect of the displacement through social integration change is -0.07 ([0.32*-0.38*-0.22] + [-0.32*0.15]). Table 6 shows all the mediation effects are statistically significant using Sobel test of unstandardized effects (Sobel 1982). The final SR model demonstrates that most of the displacement’s effect on health is mediated by secondary stressors. The deterioration of social integration accounts for 87.50% of the displacement’s effect, while income decline makes up 12.50% of the effect.
Table 6. Sobel Test for the Unstandardized Indirect Effects in the Final Structural Regression Model

<table>
<thead>
<tr>
<th>Indirect effect</th>
<th>a</th>
<th>SE_a</th>
<th>b</th>
<th>SE_b</th>
<th>ab</th>
<th>SE_ab</th>
<th>z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displace→Integration→Depression</td>
<td>-1.93</td>
<td>0.39</td>
<td>-1.50</td>
<td>0.29</td>
<td>2.89</td>
<td>0.80</td>
<td>3.61†</td>
</tr>
<tr>
<td>Integration→Depression→Health</td>
<td>-1.50</td>
<td>0.29</td>
<td>-0.02</td>
<td>0.00</td>
<td>0.03</td>
<td>0.01</td>
<td>4.20†</td>
</tr>
<tr>
<td>Displace→Integration→Health</td>
<td>-1.93</td>
<td>0.39</td>
<td>0.09</td>
<td>0.02</td>
<td>-0.17</td>
<td>0.05</td>
<td>-3.10†</td>
</tr>
<tr>
<td>Displace→Income→Health</td>
<td>-0.10</td>
<td>0.03</td>
<td>0.18</td>
<td>0.06</td>
<td>-0.02</td>
<td>0.01</td>
<td>-2.01**</td>
</tr>
</tbody>
</table>

SE_{ab} = \sqrt{b^2SE_a^2 + a^2SE_b^2}

* Indicates a coefficient is significant at the .10 level.
** Indicates a coefficient is significant at the .05 level.
† Indicates a coefficient is significant at the .01 level.
CHAPTER 5
CONCLUSION AND DISCUSSION

Conclusion

Since 1992, Three Gorges Dam Project has been receiving extensive attention both within and outside of China. However, one important question about the health impact of the Dam Project on those affected has not been given sufficient consideration, let alone vigorous scientific research. The primary aim of this study is to find out whether this development-induced displacement leads to negative health outcome. The study also attempts to identify the mechanisms by which the displacement affects health, and to determine whether the impact is direct or indirect.

In order to address the aforementioned questions, pre- and post-migration data were collected from a sample (n=1056), including both migrants and non-migrants from an area affected by the dam project. Using non-migrants as the control group, the study demonstrated that:

(1) The displacement heightened migrants’ depression, and worsened their self-rated health.

(2) The displacement was responsible for deterioration in social integration, in socio-economic status, and in community material resources, changes we conceptualized as secondary stressors.

(3) The heightened depression also led to poorer health among migrants.

(4) Among the three secondary stressors considered, the negative change in social integration led to increased depression and worsened health among migrants significantly. The decreased income also caused a significant drop in migrants’
(5) health. Although the final SEM model showed that the drops in community resources, and income, and the increase of debt may lead to heightened depression, the paths were not statistically significant.

(6) The effects of the displacement on migrants’ health were mainly mediated by undesirable changes in social integration and income. The deterioration of social integration accounted for 87.50% of the displacement’s effect on health, while income decrease made up 12.50% of the effect.

The results of the study support the hypotheses that the displacement leads to secondary stressors, and the depression causes poorer health outcomes. Because only social integration and income changes have significant effects on depression or health in the final SEM model, they provide partial support to hypotheses that secondary stressors heighten depression and affect health outcomes directly as well as indirectly. The results do not support hypotheses that the displacement effects on depression and health outcomes are direct. Consequently, I conclude that the displacement has significant negative effects on people’s health and the effects are mainly mediated by changes in social integration and income.

The stress process model is the primary theoretical framework of the analysis. However, I also incorporated the elements from two other models. In the framework, the project-induced displacement is regarded as the primary stressor suggested by Scudder and Colson’s framework. In addition, Cernea’s IRR model guided me to identify three secondary stressors: the deterioration in social integration, SES, and community resources. One advantage of the framework is to differentiate the direct effect of the displacement from its indirect effects. The results demonstrate the usefulness of this adapted stress process model for the study of project-induced displacement’s effects on migrants’ health. Meanwhile our results also show that we
can use stress process model in a non-western culture setting.

Discussion

This study has important policy implications. In the past 10 years, there have been heated debates about the benefits and costs of large dam construction internationally. The proponents argue that large dams contribute to flood control, irrigation, navigation, water supply, and power generation, while the opponents stress the degraded life quality of people displaced and the adverse effects on environment. However, like it or not, the building of large dams has continued, especially in developing countries. With increasing global energy consumption, the demand of clean energy is much more urgent than ever. Generally speaking, hydropower produces less greenhouse gases than other fuels, although with possible exception.¹ Thus, the practical question should be how to make well-designed dam projects with sound resettlement plans, which minimize the environmental harms and human sufferings. This study provides conclusive evidence of the harmful effect of displacement on people’s health based on solid empirical research. Furthermore, the study shows that the resettlement policies emphasizing only on economic factors are flawed. The major assumption of many displacement and resettlement policies is that economic compensation alone is sufficient to the restoration of livelihood for those displaced (Cernea and Mathur 2008). My study indicates that this assumption is unsound in light of the health impact of displacement. To restore and improve people’s health after displacement, social integration is at least as important as the economic factors. This research is helpful for the planning of future dams and other development projects not only in China, but also in other developing countries such as India, Brazil, and others.
Although the effects of the displacement on self-rated health is statistically significant, the effect size is small. There are two reasons for that: the study covers only a short period, while the displacement effect on health may take longer to fully unfold. Furthermore, China has learned important lessons from previous failed resettlement programs, and has reformed its resettlement policies since late 1980s to introduce ‘the Developmental Resettlement Policy.’ The new policy emphasizes developing the local economy to improve the life quality and employment opportunities for the displaced. Besides the compensation of land and housing, the government allocates funding earmarked for developing local economy and infrastructure in areas affected. World Bank resettlement experts consider the new resettlement policy much superior compared to those of other developing counties, and China is one of the best to maintain the real income for the displaced (Heggelund 2004). The notable successful resettlement programs in China’s Shuikou Dam Project and Xiaolangdi Dam Project are recommended by the World Bank as exemplars (Oliver-Smith 2009; Wet 2006). This study also found that although migrants experienced relative loss in income compared to non-migrants, they didn’t experience absolute income decrease (see chapter 4, table 5). According to Hwang, Cao and Xi (Forthcoming), the TGDP migrants enjoy not only absolute improvement in living conditions, but also slight relative improvement in terms of per capita living space, house condition, home ownership, and access to running water compared with non-migrants. The improved housing, clean water access, and purchasing power help to prevent most infectious diseases caused by malnutrition, poor hygiene, overcrowding, stings and bites from insects, snakes, and rodents (Jayewardene 1995). There is no report about the outbreak of infectious diseases in TGDP area so far.

Another finding warranted further discussion is about the high average
depression level of non-migrants even though they didn’t experience the displacement stress. First, these non-migrants live in an area characterized by long time under-investment. As a result, the local residents suffering from inconvenient transportation, poor infrastructure, low living standard and low educational level for many years before the construction of the dam. Since 1949, the government has withheld investment in anticipation of the dam project (Jackson and Sleigh 2000). Any investment could be wasted because the entire area would be submerged under the reservoir once the dam is built. For example, from 1950 to 1985 the investment per capita for Yunyang County, one of the affected counties, is only 9.26% of China’s average (Wei 1999). Second, in the construction phase of a big development project, there was a sudden increase in population, cultural conflicts, and social disruption in these communities because of the “boom town effect”, which affect not only migrants but also on non-migrants in the TGDP area (Bougst, Marshall, and Chavez 1983; Jayewardene 1995; Summers and Branch 1984; Wilkinson et al. 1982). Third, the displacement may have contamination effects on non-migrants (Xi 2007). Although non-migrants are exempted from the displacement, they may have relatives who need to be displaced. For example, 55.86% of the non-migrants in the sample have relatives as migrants. In Chinese culture, they are supposed to support their relatives even though they have limited resources.

Limitation and Future Direction

This study uses panel data to establish a solid causal link between the displacement and secondary stressors, depression and health. However, a definite test of mediation effects of secondary stressors needs at least three waves data (Collins, Graham, and Flaherty 1998), although two waves data is definitely superior to the
cross-sectional data for establishing the mediation effect (Cole and Maxwell 2003). Another limitation of this study is the 3-year period is relatively short considering the health impacts may take longer to display.

Third, there are 286 designated migrants who have not moved at the second survey. We put them in the ‘not displaced’ group because they didn’t experience the displacement. However, they were scheduled to move sometime after the wave 2 data collection. The possible difference between them and other non-migrants could lead to bias in analysis. We conducted a sensitivity analysis, which found significant differences between migrants-not-moved and non-migrant in social network size, per capita debt, and education resources (see Appendix C for details).

Finally, the attrition of the sample is not random, with migrants being more likely to be missed in the follow-up survey. There is a possibility of bias in analysis even though we control the attrition correction factor. Consequently, it is reasonable to expect a third wave survey as the next step. The future studies will examine the long term effects of the displacement on health and test the mediation effect of secondary stressors using three-wave data.
NOTES

Chapter 1 Notes:


2. Although Yangtze River has brought many benefits to China including rice production, irrigation, and navigation, it has also wreaked havoc to those who reside along the basins due to frequent flooding, resulting in periodic losses of lives and properties. The following table summarizes the damages of five largest floods in 20th century on Yangtze River.

<table>
<thead>
<tr>
<th>Year</th>
<th>Affected population</th>
<th>People killed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1931</td>
<td>28,550,000</td>
<td>145,200</td>
</tr>
<tr>
<td>1935</td>
<td>10,030,000</td>
<td>142,000</td>
</tr>
<tr>
<td>1949</td>
<td>8,100,000</td>
<td>5,699</td>
</tr>
<tr>
<td>1954</td>
<td>18,880,000</td>
<td>33,169</td>
</tr>
<tr>
<td>1989</td>
<td>2,316,000</td>
<td>1,526</td>
</tr>
</tbody>
</table>

Source: China Three Gorges Project Corporation

3. The number of TGDP-induced migrants is the most controversial one between the Dam Project proponents and opponents. It ranges from 725,500 to 1,980,000 (see Qi’s article (1998) for details). When the Seventh National People’s Congress passes The Resolution to Construction of Three Gorges Project in 1992, the estimated population of relocation is 1.13 million. Later 1.2 million becomes a frequently quoted number in the press. Now according to China’s official news agency, Xinhua News Agency, 1.27 million people
has been resettled by June 2009, and the number will reach 1.4 million finally (Zhang 2006; Zhang and Tang 2009). The size of estimated population reported depends not only on the calculation method, inundation date, project complete date, the reservoir water level, and the population growth rate, but also on the motives of those who provide the estimates. The local government and the migrants’ family tend to exaggerate the number to qualify for more compensation, while the central government prefers smaller estimate to justify the Dam Project feasibility. To make it more complicated, the Dam Project is generating a large number of unexpected resettlers because of riverbank collapses and landslides in the reservoir area according to recent report (Deng 2009). In my study, I use 1.4 million for general reference, but the actual number could be larger.

4. The Opium War: the major cause of this war was the British government’s decision to protect its merchants’ trade smuggling Indian opium into China. The Britain’s success of the war forced the Chinese imperial government to agree importing opium and giving up Chinese protective tariffs. Thus it opened up the Chinese market. The Opium War is regarded as the beginning of modern Chinese history in literature.

5. Dr. Sun Yat-Sen is one of the founders of KMT (translated as ‘the Chinese Nationalist Party’). KMT is the founding political party of the Republic of China (ROC).

6. Tennessee Valley Authority (TVA)’s involvement into the planning of the Dam Project began from 1944. TVA has been considered as a role model for the Dam Project since then, and it still holds high regard in China now (see Freeman 1998; Jones and Freeman 2000) for details).
Chapter 2 Notes:

1. According to Turton (2006), involuntary migration is not a correct English word in two ways: first, the opposite of ‘voluntary’ is ‘compulsory’, not ‘involuntary’; second, ‘migration’ is something a person does actively, not passively. In other words, people can ‘migrate’, but not be ‘migrated’. Based on the second reason, neither forced nor compulsory migration is an appropriate word; forced or compulsory displacement would be preferred. However, because involuntary migration and forced migration are commonly used words in the literature, I still keep them in the manuscript.

2. In literature, migration and migrants were used in both voluntary and compulsory situation, but displacement, relocation, resettlement, dislocation, resettlers, relocatees, displaced persons, oustees, and refugees are usually applied to forced migration. Some scholars in this field point out that the ambiguous and imprecise categories and concepts are the product of “practical politics and humanitarian assistance” rather than of scientific considerations (Black 2001; Hansen 1996; Turton 2006). If only one or two of these terms are used to search the literature titles or abstracts, the findings of literature will be incomplete.

3. Although refugee is a legal term defined in the 1951 United Nations (UN) Convention Relating to the Status of Refugees, nowadays the concept has been broadened to encompass other people who are in the same situation, but not cross the country border. People displaced by disasters (natural or human-made) sometimes are also called as refugees in literature (Cernea 1993; Scudder and Colson 1982).

4. The displacement caused by environmental conservation project is also
regarded as development-induced displacement in literature (Penz 2005).

5. A good example is the disaster-induced displacement in TGDP reservoir area mentioned in chapter 1.

6. Schistosomiasis is a chronic infection caused by schistosomes, which are a genus of trematode worms and are parasitic in the blood of human beings. It can damage the tissues of the kidneys, liver, and other organs. Yangtze River Valley is one of the endemic area in China (Jobin 1999).

7. Psychosomatic Medicine is a multidisciplinary area concerning the disorder having physical symptoms but derived from social and psychological causes.

8. Although we can’t measure primates’ status using education, occupation, and income, their ranking in the group can be determined by observing other variables, like the access to food or female, etc.
Chapter 3 Notes:

1. Several survey datasets deposited at the ICPSR by John R. Logan and Yanjie Bian (No. 2571), and Yi Zeng and James W. Vaupel (No. 3891) also got the response rate higher than 95% in China.

2. The final sample has 1056 subjects, including 350 non-migrants, 286 designated migrants who have not moved at the second survey, and 420 designated migrants who have moved. I excluded 14 respondents because they had moved before the first survey but returned to their residence temporarily and were captured by mistake in the pre-migration survey.

3. I regress a dummy dependent variable, which indicates whether a respondent captured in wave 1 was missed in wave 2, on six socio-demographic variables (migration status, gender, age, education, house income, and urban/rural residence) measured at time 1 using a linear probability model.
Chapter 4 Note:

1. $\chi^2$ is the model chi-square, which is a “badness-of-fit” index (Kline 2005: 135), the lower value indicates better model fit. When it equals to zero, the model perfectly corresponds to the data. Root Mean Square Error of Approximation (RMSEA) is also a “badness-of-fit” index, which takes sample size and model complexity into account. RMSEA value lower than 0.05 means the good model fit. If $p$ (RMSEA $< 0.05$) is larger than 0.05, it means that statistically we accept that RMSEA $< 0.05$. 
Chapter 5 Notes:

1. According to Joyce (1997), large shallow reservoirs can produce a lot of carbon dioxide from the biomass decay.

2. CES-D scores of 16 or higher have been characterized as cutoff point for identifying the risk groups of depressive disorder (Xi 2007).
LIST OF REFERENCES


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# APPENDIX A

## MEASUREMENT OF CES-D

Center for Epidemiologic Studies Depression Scale (CES-D), NIMH

Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.

<table>
<thead>
<tr>
<th>Week</th>
<th>During the Past</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rarely or none of the time (less than 1 day)</td>
</tr>
<tr>
<td>1.</td>
<td>☐</td>
</tr>
<tr>
<td>2.</td>
<td>☐</td>
</tr>
<tr>
<td>3.</td>
<td>☐</td>
</tr>
<tr>
<td>4.</td>
<td>☐</td>
</tr>
<tr>
<td>5.</td>
<td>☐</td>
</tr>
<tr>
<td>6.</td>
<td>☐</td>
</tr>
<tr>
<td>7.</td>
<td>☐</td>
</tr>
<tr>
<td>8.</td>
<td>☐</td>
</tr>
<tr>
<td>9.</td>
<td>☐</td>
</tr>
<tr>
<td>10.</td>
<td>☐</td>
</tr>
<tr>
<td>11.</td>
<td>☐</td>
</tr>
<tr>
<td>12.</td>
<td>☐</td>
</tr>
<tr>
<td>13.</td>
<td>☐</td>
</tr>
<tr>
<td>14.</td>
<td>☐</td>
</tr>
<tr>
<td>15.</td>
<td>☐</td>
</tr>
<tr>
<td>16.</td>
<td>☐</td>
</tr>
<tr>
<td>17.</td>
<td>☐</td>
</tr>
<tr>
<td>18.</td>
<td>☐</td>
</tr>
<tr>
<td>19.</td>
<td>☐</td>
</tr>
<tr>
<td>20.</td>
<td>☐</td>
</tr>
</tbody>
</table>

**SCORING:** zero for answers in the first column, 1 for answers in the second column, 2 for answers in the third column, 3 for answers in the fourth column. The scoring of positive items is reversed. Possible range of scores is zero to 60, with the higher scores indicating the presence of more symptomatology.

Source: (Radloff 1977).
APPENDIX B

MEASUREMENT OF PERCEIVED ROUTINE SUPPORT

Perceived Routine Support
I would like to present you with some hypothetical situations. I want to know if you could get help or assistance in the following areas on a regular basis if you needed it. By regular, I mean at least 2–3 times a week. Remember, these are hypothetical situations. Please use the following response categories:

3. Yes
2. Yes, with difficulty
1. No

1. Someone to lend you money to pay bills or help you get along?
2. Someone to help in doing things around the house (i.e., cooking, cleaning)?
3. Someone to give you a ride to someplace you had to go (shopping, post office, airport)?
4. Someone to help with your daily routine if you were not feeling well?
5. Someone to watch your house (care for plants/pets) while you were away?
6. Someone to talk to about something that was bothering you?
7. Company when you felt lonely or just wanted to talk?
8. Someone to talk to about a small argument you had with your husband/wife or closest friend?
9. Someone to make you feel good, loved, or cared for?
10. Someone to talk to about a series of disappointments or bad days?

Source: (Lin et al. 1999)
### APPENDIX C

**DID SCORES MEASURING THE DIFFERENCE BETWEEN MIGRANTS-NOT-MOVED VS. NON-MIGRANTS**

<table>
<thead>
<tr>
<th>Social Integration</th>
<th>Migrants-not-move</th>
<th>Non-migrant</th>
<th>Differences</th>
<th>Unadjusted DID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Routine Social Support (10 Items)</td>
<td>34.84</td>
<td>35.87</td>
<td>1.03</td>
<td>0.08</td>
</tr>
<tr>
<td>Social Network Size (0-5)</td>
<td>34.62</td>
<td>34.97</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>Rapport with Neighbors (1-5)</td>
<td>3.86</td>
<td>3.94</td>
<td>-0.08</td>
<td>0.24 *</td>
</tr>
<tr>
<td>Social Economic Status</td>
<td>3.75</td>
<td>3.80</td>
<td>-0.05</td>
<td>0.00</td>
</tr>
<tr>
<td>Per Capita income ($)</td>
<td>4.08</td>
<td>4.11</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>Per Capita Debt ($)</td>
<td>3.95</td>
<td>3.98</td>
<td>0.03</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Community Material Resources</th>
<th>Migrants-not-move</th>
<th>Non-migrant</th>
<th>Differences</th>
<th>Unadjusted DID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Resources (1-5)</td>
<td>2742.74</td>
<td>3885.81</td>
<td>1143.07</td>
<td>-8.10</td>
</tr>
<tr>
<td>Education Resources (1-5)</td>
<td>2929.94</td>
<td>3901.11</td>
<td>1151.17</td>
<td></td>
</tr>
<tr>
<td>Shopping Resources (1-5)</td>
<td>933.50</td>
<td>2427.41</td>
<td>1493.91</td>
<td>1028.78 †</td>
</tr>
<tr>
<td>Entertainment Resources (1-5)</td>
<td>722.96</td>
<td>1187.69</td>
<td>464.73</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Migrants-not-move</th>
<th>Non-migrant</th>
<th>Differences</th>
<th>Unadjusted DID</th>
</tr>
</thead>
<tbody>
<tr>
<td>CES-D (20 Items)</td>
<td>20.73</td>
<td>21.30</td>
<td>0.57</td>
<td>-0.46</td>
</tr>
<tr>
<td>Self-Rated Health (1-5)</td>
<td>20.89</td>
<td>21.91</td>
<td>1.02</td>
<td>-0.12</td>
</tr>
</tbody>
</table>

* Indicates a coefficient is significant at the .10 level.
** Indicates a coefficient is significant at the .05 level.
† Indicates a coefficient is significant at the .01 level.
APPENDIX D

INSTITUTIONAL REVIEW BOARD APPROVAL FORM
Protection of Human Subjects
Assurance Identification/IRB Certification/Declaration of Exemption
(Common Rule)

Policy: Research activities involving human subjects may not be conducted or supported by the Departments and Agencies adopting the Common Rule (56FR23803, June 18, 1991) unless the activities are exempt from or approved in accordance with the Common Rule. See section 101(b) of the Common Rule for exemptions. Institutions submitting applications or proposals for support must submit certification of appropriate Institutional Review Board (IRB) review and approval to the Department or Agency in accordance with the Common Rule.

1. Request Type
[] ORIGINAL
[] GRANT
[] CONTRACT
[] FELLOWSHIP
[] EXEMPTION
[] OTHER:

2. Type of Intercourse
[] CONTINUATION
[] COOPERATIVE AGREEMENT

3. Name of Federal Department or Agency and, if known, Application or Proposal Identification No.

4. Title of Application or Activity
Involuntary Migration in China’s Three Gorges (R01HD40243)

5. Name of Principal Investigator, Program Director, Fellow, or Other
HWANG, SEAN-SHONG

6. Assurance Status of this Project (Respond to one of the following)
[ ] This Assurance, on file with Department of Health and Human Services, covers this activity:
   Assurance Identification No. FWX00005980, the expiration date 10/26/2010. IRB Registration No. IRBX00000726

[ ] This Assurance, on file with (agency/dep) ______, the expiration date ______. IRB Registration/Identification No. _______ (if applicable)

[ ] No assurance has been filed for this institution. This institution declares that it will provide an Assurance and Certification of IRB review and approval upon request.

[ ] Exemption Status: Human subjects are involved, but this activity qualifies for exemption under Section 101(b), paragraph ______.

7. Certification of IRB Review (Respond to one of the following if you have an Assurance on file)
[ ] This activity has been reviewed and approved by the IRB in accordance with the Common Rule and any other governing regulations.
   by: [ ] Full IRB Review as of (date of IRB meeting) _______ or [ ] Expedited Review on (date) 9-5-08

[ ] If less than one year approval, provide expiration date _______.

[ ] This activity contains multiple projects, some of which have not been reviewed. The IRB has granted approval on condition that all projects covered by the Common Rule will be reviewed and approved before they are initiated and that appropriate further certification will be submitted.

8. Comments
Protocol subject to Annual continuing review.
HIPAA Waiver Approved?: N/A

IRB Approval Issued:
9-5-08

9. The official signing below certifies that the information provided above is correct and that, as required, future reviews will be performed until study closure and certification will be provided.

10. Name and Address of Institution
University of Alabama at Birmingham
701 20th Street South
Birmingham, AL 35294

11. Phone No. (with area code) (205) 934-3789
12. Fax No. (with area code) (205) 934-1301
13. Email: smoore@uab.edu

14. Name of Official
Marlyn Doss, M.A.

15. Title
Vice Chair, IRB

16. Signature

17. Date
9-5-08

Public reporting burden for this collection of information is estimated to average less than an hour per response. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to: US Reports Clearance Officer, Room 3513 30th Independence Avenue, SW, Washington, DC 20201. Do not return the completed form to this address.
6. For each investigator and staff member involved in the design, conduct and reporting of the research answer the questions below:

The following definitions are used for Item #6:
Immediate family means spouse or a dependent of the employee. Dependent is any person, regardless of his or her legal residence or domicile, who receives 50% or more of his or her support from the public official or public employee or his or her spouse or who resided with the public official or public employee for more than 180 days during the reporting period.

Financial Interest Related to the Research means financial interest in the sponsor, product or service being tested, or competitor of the sponsor.

Have each investigator and staff member involved in the design, conduct and reporting of the research answer the questions below:
(Repeat this section for each individual)

Name: Sean-Shong Hwang
Do you or your immediate family have any of the following? (Check all that apply)
- An ownership interest, stock options, or other equity interest related to the research of any value.
- Compensation related to the research unless it meets two tests:
  - Less than $10,000 in the past year when aggregated for the immediate family.
  - Amount will not be affected by the outcome of the research.
- Proprietary interest related to the research including, but not limited to, a patent, trademark, copyright, or licensing agreement.
- Board of executive relationship related to the research, regardless of compensation.

If you checked any of the above, a financial interest disclosure has to be submitted to or currently on file with the CIRB and the completed CIRB Evaluation has to be available before the IRB will conduct its continuing review.

Name: Yue Cao
Do you or your immediate family have any of the following? (Check all that apply)
- An ownership interest, stock options, or other equity interest related to the research of any value.
- Compensation related to the research unless it meets two tests:
  - Less than $10,000 in the past year when aggregated for the immediate family.
  - Amount will not be affected by the outcome of the research.
- Proprietary interest related to the research including, but not limited to, a patent, trademark, copyright, or licensing agreement.
- Board of executive relationship related to the research, regardless of compensation.

If you checked any of the above, a financial interest disclosure has to be submitted to or currently on file with the CIRB and the completed CIRB Evaluation has to be available before the IRB will conduct its continuing review.

7. Since the last IRB review, have you received any of the following types of information?
   a. Multi-center trial reports? Yes No
      If yes, attach a copy of any multi-center trial reports not previously forwarded to the IRB, and summarize those reports here: ______