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The Short-Term Impact of Involuntary Migration in China's Three Gorges: A Prospective Study

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Abstract The aim of this study is to measure the short-term impact of involuntary migration resulting from China's Three Gorges Dam project on the 1.3 million persons being displaced. We focus on the social, economic, and mental and physical health impact using three sets of indicators. Using a prospective research design, we gathered information about these indicators from a sample of migrants first before they moved and then again after they moved. Changes in the migrants' wellbeing during the period, when benchmarked to corresponding changes computed for a control group of non-migrants, are attributed to the impact of involuntary migration. Our results showed that although the displaced have enjoyed a relative gain in housing quality, most of the changes were in the negative direction and many of such negative changes were statistically significant.

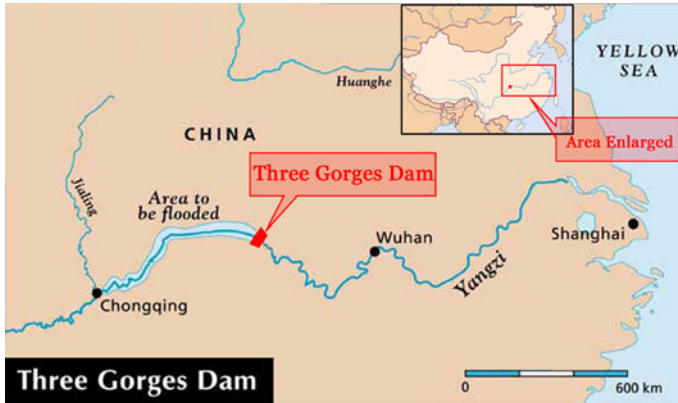
Keywords Involuntary migration · Three Gorges · Prospective research

Although it has been 15 years into the construction of the Three Gorges Dam, the world's largest hydroelectric project located in the mid-section of China's Yangtze River (see map), the question as to whether the controversial project should have been approved in the first place, while seemingly a bygone conclusion, still lingers.

Controversy about the dam is not new—it has been fermenting for nearly a century since the idea of building a dam to harness the Yangtze was first conceived by Dr. Sun Yet-sen, the new Republic's founding father. The idea was revisited by Mao and his successors and was finally approved, albeit not without reservations, in the early 1990s. While building a dam on the river promises many benefits including flood control, hydroelectricity, improved navigation, and the economic development of China's vastly undeveloped West, its potential risks to the environment and the displaced are less certain and their discussion often suppressed (Dai 1998; Jing 1997; Wei 1999).

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Source: International Rivers, © Eureka Cartography

Recently, the dam has been blamed, among other problems, for the far too frequent incidences of land slides along the river's banks and increased pollution in its tributaries and the newly formed reservoir. Enthusiasm about the reservoir's navigation benefits is also dampened by the rapid build-up of silt as the dam slows the flow of the river. Many of the displaced are unable to make ends meet, and those who have moved to higher ground are contributing to the erosion and land slides. In a recent forum held in Wuhan, Chinese experts warned that these problems, if not addressed in a timely manner, could result in a catastrophe. One proposed solution to mitigate these problems is to relocate an additional two million Chinese farther away from the reservoir area on top of the 1.3 million displaced originally planned for (BBC News 2007; New York Times 2007; Wall Street Journal 2007).

Although media coverage of the Three Gorges Project (TGP) abounds, journalistic accounts are often driven by the newsworthiness of the events in question. Furthermore, information gathered and reported, even by respectable journalists, cannot be generalized since they are often done in a non-systematic manner. Thus, while there are frequent reports of how the lives of the displaced are being adversely affected, it is difficult to construct a complete picture from these accounts because they are often based on interviewing no more than a handful of conveniently selected individuals. There is, however, a growing Chinese literature on the ongoing involuntary migration in the TGP, but it is largely inaccessible to researchers in the West.¹ Most of these publications lack scientific rigor using standards typically applied to academic publications in the United States. Furthermore, most of these studies have been based on pre-migration surveys and therefore are inadequate to address research questions about the migration's impact, as doing so requires post-migration measures (see Li et al. (2001) for a review of Chinese literature). English literature which empirically addresses the impact of the involuntary migration in the Three Gorges is considerably smaller (Duan and Steil 2003; Gleick 2009; Hwang et al. 2007; Jim and Yang 2006; Li and Rees 2000; Li et al. 2001; Steil and Duan 2002; Xi et al. 2007).

This paper represents one of the first to provide systematic and methodologically sound assessment of the impact of the TGP-induced population displacement on the lives of the 1.3 million Chinese who have been involuntarily relocated. To accurately measure such impact, we used a prospective panel design to gather both pre- and post-migration

¹ A review of Chinese literature by Feng (2006) counts 133 publications between 1994 and 2003.

measures of the outcomes of interest. Because observed changes in these outcomes can result from concomitant changes in China's economic conditions unrelated to the TGP but affect all Chinese, we included a comparison group of non-migrants to control for such unintended influences (Campbell and Stanley 1966; Winship and Morgan 1999).

Before turning to the findings, we will begin with a brief discussion of the TGP-induced population relocation effort. The conceptual framework guiding the study will be presented next. Third, we will discuss the data and the research design. The results of our analysis are then presented. Finally, we discuss the scientific and policy implications of the findings.

1 The TGP and the Resulting Mass Population Resettlement

In 1994, China began the construction of the TGP on the Yangtze River. It is intended to control recurring floods in one of China's most populated regions, to generate 84.7 billion kilowatt-hours of pollution-free electric power annually to fuel China's economic expansion, and to facilitate development in China's interior by means of improved navigation. When completed, the dam will form a 385-mile-long reservoir enabling the passage of 10,000-ton barges between Chongqing and Shanghai (Tao 1994). The improved navigation will enhance economic development in Western China and effectively narrow the developmental gap between China's interior and coastal regions. The resulting reservoir, however, will raise the water level of the river from 90 to 175 m, completely or partially flooding 13 cities and towns, 365 townships, and 1,711 villages in 20 counties in Hubei and Sichuan (Tao 1994). About 25.9 thousand hectares of farmland would be lost (Weng 1999) and at least 1.3 million residents (59% urban and 41% rural) must be relocated (Duan and Steil 2003; Gleick 2009).

To accomplish this massive population relocation effort, the government initially envisioned a plan which would resettle most of the displaced to the higher ground within the same county in the flooded area if possible, and to adjacent counties in the same province if necessary (Li 1998). Guided by a proactive policy known as *Development-oriented Resettlement* (Cernea 1997), the government promised to restore the livelihoods of the displaced by taking several initiatives designed to assure a smooth re-adaptation and sustainable resettlement (Li and Rees 2000; Padovani 2006). Thus, in addition to paying the displaced a monetary compensation,² as it was typically done in the past, the government would allocate a large sum of relocation fund for building new towns, constructing basic infrastructures, reclaiming new land, and creating manufacturing and service jobs for the displaced (Li 1998).

While the plan has been implemented with some success for urban displaced, it has largely failed for their rural counterpart (Duan and Steil 2003; Jim and Yang 2006; Li et al. 2001; Padovani 2006; Steil and Duan 2002). Restoring the livelihood of farmers, for example, requires converting steep hillside slopes into farmland. In response to increased incidences of landslide and flooding directly tied to deforestation and erosion, the central government in 1999 called for a revamped resettlement strategy which significantly reduced the number of locally resettled displaced and increased the percentage of people who must be resettled out of the region to 12%. The governments in 10 Provinces (Anhui,

² The compensation is determined by a complex formula involving many factors such as location, size, quality, and types of land that would be submerged, size and quality of house, and transportation costs (Li et al. 2001; Yue 2007) and therefore is very unequal. It is also generally inadequate because it was based on dated assessed values without inflation adjustment instead of replacement costs.

Guangdong, Fujian, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Shandong, Zhejiang) and Shanghai which would be benefited by the TGP most were pressured to form partnerships with the flooded counties by either helping them to create non-agricultural jobs locally or to host a certain number of displaced in exchange for tax benefits and preferential treatments. Although there have been a few success stories, most enterprises that were brought into create new jobs for farmers have failed (Li and Rees 2000; Steil and Duan 2002). Although the central government provide additional incentives for the displaced to move to other Provinces, making a successful transition in other Provinces has been particularly challenging for rural migrants as it often requires them to compete with farmers in the host societies for land, to learn to grow a new crop or to take an unfamiliar job in non-agricultural sector, and to comprehend a different dialect. Furthermore, the kin-based network of many rural displaced is shattered in the process because it is necessary to divide larger villages into smaller units to reduce the accommodation burden on the host (Feng 2006; Li et al. 2001; Yue 2007). The effectiveness of the state-mandated partnership program is also challenged because the central authority is considerably weakened as China moves toward a market economy (Steil and Duan 2002).

2 Project-Induced Displacement: A Conceptual Framework

The primary purpose of this study is to provide a systematic assessment of the short-term impact of the TGP-induced displacement on the displaced population. Because no dominant paradigm exists for this type of studies in social sciences, we took an inductive approach to cull indicators of impact used in past research on developmental projects. Our literature review covers academic literature directly related to projects in China (Dai 1998; Duan and Steil 2003; Feng 2006; Gleick 2009; Hwang et al. 2007; Jim and Yang 2006; Jing 1997; Li and Rees 2000; Li et al. 2001; Podovani 2006; Qi 1998; Steil and Duan 2002; Xi and Feng 2001; Xi et al. 2007; Yue 2007; Zhu 1996)³ and in other countries (Cernea 1997; Fernea and Kennedy 1966; Kennedy 1978; Robinson 2003; Scudder and Colson 1982; Shami 1993; World Bank 1994).

The inductive effort has netted a large number of indicators that have been used in past research and theoretical discussions. These indicators overlap extensively with past inductive efforts codified in the works of Scudder and Colson (1982), Cernea (1997), and Robinson (2003). We group these indicators into three broad categories (economic, social, and health) and discuss their relevance to our research interest in the following sections. Our conceptual frame captures six of the eight displacement risks included in Cernea's (1997) *risks and reconstruction model*, a model which has been promoted to project planners as a tool to anticipate and preempt common displacement risks, and to restore the life of the displaced after relocation. Although Cernea's model has had some influences on resettlement practices and policies for development projects funded by the World Bank, its potentials as a tool for research remains largely unexplored.

2.1 Social Consequences

One of the major concerns about the wellbeing of project-induced migrants is whether or not they are able to socially adapt in their new home. Project-induced displacement can be

³ This includes second-hand reading of a large volume of Chinese writings reviewed in these studies but is not easily accessible to English readers.

socially destructive because it uproots the displaced from their familiar social environment and transplants them to a socially foreign host society (Cernea 1997; Scudder and Colson 1982). Such transplanting almost always requires the displaced to both sever old social ties established in the sending community over a long period of time and build new ones in the receiving community. In addition, project-induced displacement involves change in cultural surroundings (Feng 2006; Li and Rees 2000) and thus necessitates the displaced to learn the language, customs, and new way of life of the host society.

Involuntary migration in the Three Gorges is expected to have grave social ramifications as well. Ninety-nine percent of residents in this region have never moved in their lifetime (Zhu 1996). Although a majority of the designated migrants prefer to resettle close to their old home (Li and Rees 2000; Zhu 1996), a large proportion of them must relocate to some place afar due to the shortage of farmland in the region (Tao 1994).⁴ Furthermore, ecological constraints at resettlement sites and logistic considerations necessitate breaking up many larger villages and sending villagers of the same clan in fragmented units to different destinations (Heggelund 2004; Yue 2007). The relocation, therefore, not only uproots the displaced from their ancestral home, it also tears apart their close-knit social networks (Hwang et al. 2007).

Thus, one useful way to gauge the social impact of the displacement is to examine the pre- and post-migration differences in the migrants' social relationships and their perceived changes in social support. Furthermore, difficulties in social adaptation may result from cultural differences. For example, although all Chinese share the same written language, there are significant differences in the dialects spoken in different provinces and sometimes even in different counties of the same province. Thus, the displaced are likely to perceive a reduction in social support in the destination community not only because of their newness but also because of cultural differences. The displaced are expected to adjust more easily when migration incurs little social and cultural changes.

2.2 Economic Consequences

A common challenge the displaced must face in the host society is to secure a livelihood for his/her family. A secure livelihood is possible only if the migrant possesses enough resources either from gainful employment or from savings or other sources. It is well documented that migrants resulting from project-induced displacement often suffer a setback in their economic wellbeing which Cernea (1997) refers to as *economic marginalization* due to factors such as discrimination, language barriers, and the non-transferability of skills from one context to another. These factors tend to make finding a job, especially a well-paying job, difficult for migrants. Thus, a migrant may be denied a job if he/she is unable to speak the language/dialect prevalent in the host society's labor market (Feng 2006; Li and Rees 2000). Aside from language barriers, a peasant of rural origin is unlikely to find a suitable job in an urban destination where the skills useful for farming have little use (Li et al. 2001; Zhu 1996).

Previous studies of project-induced migration have indicated that the displaced often become homeless, landless, and jobless (Cernea 1997; Li and Rees 2000; Li et al. 2001; Hansen and Oliver-Smith 1982; Jing 1997; Scudder and Colson 1982). Involuntary migrants in China's Three Gorges region are particularly susceptible to such economic

⁴ For example, only 58% of the displaced in our sample are resettled in a nearby location, the rest of them must either move to a distant location within the same county (17%), a different county (14%), or out of the Province (11%).

adversities because of a scarcity of arable land in the resettled region (Jim and Yang 2006; Heggelund 2004). Steep terrain, in conjunction with a newly awakened environmental consciousness in China, further limits the migrant farmers' options to convert hillsides into farmland—a solution that had been earlier conceived by the planners but had to be abandoned later. As a result, many peasants are required to give up farming and forced into occupations for which they have neither skills nor qualifications (Li 1998; Li and Rees 2000; Tao 1994; Zhu 1996). In addition, the likelihood that displaced farmers will be absorbed by non-farm industries is slim because factory jobs are scarce in this region (Li 1998; Tao 1994; Zhu 1996). Government efforts to lure factory jobs to the region have been unsuccessful (People's Daily 1999; South China Morning Post 2006; Washington Post 2006). As a result, many displaced farmers have become jobless and must now survive on meager government allowances (New York Times 1999; Washington Post 2006).

Thus, one can assess the economic impact of project-induced displacement by not only comparing the pre- and post-migration measures of levels of employment, earnings, and debts, but also by monitoring the changes in standard of living among the displaced that are tied to these economic measures.

2.3 Mental and Physical Health Consequences

One aspect of migration consequences which has received a great deal of scholarly attention is the mental and physical health impacts of migration (Beiser 2005; Hwang et al. 2007; Noh and Avison 1996; Porter and Haslam 2005; Salmond et al. 1985). Migration, especially involuntary migration, is often stressful because it forces migrants to make painful social sacrifices and economic readjustments with uncertain benefits in return. Thus, project-induced displacement can negatively impact the mental health of the displaced not only because of the hassle associated with moving, but also indirectly by consuming their social and economic resources, which are known to safeguard people from mental and physical illness (Hwang et al. 2007; Lin et al. 1999; Noh and Avison 1996). As was made clear in the preceding discussion of the social and economic impact, forced relocation often dismantles existing social networks, and thus reduces the social support the displaced can draw from these networks. In addition, forced relocation requires the displaced to give up their home, land, and job and build a new home, work on unfamiliar and often inferior land, or start a new job in unfamiliar territory. All of these adjustments can be very challenging both mentally and physically. Furthermore, maladjustment in any of these aspects is expected to lead to temporary or chronic strains in the social and economic life of the displaced which, in turn, can translate into negative repercussions in mental health (Hwang et al. 2007; Porter and Haslam 2005; Rumbaut 1991). Although the physical health impact of migration has not received as much attention as has mental health (Beiser 2005; Kasl and Berkman 1983; Salmond et al. 1985), there are strong theoretical justification to include it in our framework given the well documented association between mental and physical health (Bammer and Newberry 1981; Cohen and Williamson 1991).

3 Data and Methods

The data used in this analysis come from a prospective panel study involving two waves of interviews spaced 3 years apart. Our pre-migration survey sample consists of 975

designated migrants⁵ and 555 non-migrants recruited from five communities randomly selected from the Wanxian Relocation and Development Region (WRDR), where 80% of the designated migrants resided (Weng 1999). Although we planned to select communities (clusters) using the probability proportional to size (PPS) technique, the ongoing out-migration made it impossible to make accurate estimates of cluster sizes. Our final sample was thus based on a mixture of systematic sampling of households for large communities and cluster sampling for small communities. Selecting migrants and non-migrants from the same area but differing only in elevation minimizes preexisting differences between the two groups and increases our confidence to attribute post-migration differences to migration.

The pre-migration survey was conducted in late 2002 and early 2003 by 29 sociology graduate students from two Chinese universities. For each sampled household, a 30–45 min face-to-face interview was conducted with a qualified respondent (an adult 16 years of age or older) from whom information about the respondent as well as the household was collected. The response rate of 99% is high by most standards, but is typical of the practices of face-to-face interviews in China (Feng 2007).

Our sample is made up of 51% urban and 49% rural residents. We over-sampled urban residents to reduce costs because rural residents are more dispersedly distributed. Fifty-five percent of our respondents are female, and the sample has an average age of 45 and an average educational attainment of 7.48 years. The apparent “overrepresentation” of women, older, and less educated respondents reflects the high out-migration rate of the region even before the TGP started (Liang and Zhongdong 2004; Roberts 1997; Solinger 1999). A comparison of the demographic profile of our *sampled households* with the 2000 census results for the region (Chongqing Statistical Yearbook 2003) indicates that our sampled households closely mirror the population in terms of age, sex, educational composition, and average family size. Preliminary analysis indicated that our migrants and non-migrants had very similar socio-demographic profiles.

The post-migration survey was conducted in early 2006 using the same method as the pre-migration survey. We successfully traced and interviewed 1,070 subjects, with a recapture rate of about 70%.⁶ Because our initial sample for the pre-migration survey mistakenly included 14 migrants who had moved but returned to the community temporarily, we deleted them from the analysis because they were not part of the sampling frame. As a result, our effective sample size reduced to 1,056, of which 350 are non-migrants, 286 are designated migrants who had not yet moved at the time of second survey, and 420 are designated migrants who had moved. The designated migrants who had not yet moved at the time of the second survey consisted of those who lived in places of higher elevation. The relocation of people from the areas being inundated was scheduled to take place in three stages. The reservoir impoundment initiated the first-stage inundation in 2003, raising the water level from 96 to 135 m. The second and third stages of inundation were scheduled to arrive in 2006 and 2009, projected to lift the water level to 156 and 175 m, respectively (Jim and Yang 2006). Because the 286 designated migrants who had not yet moved did not actually experience the migration, they are excluded from the analysis reported below.

⁵ Designated migrants are those who lived below the 175 m above the sea level line, a line demarcating the area that would be flooded upon completion of the project. Families which lived above the line were not required to move.

⁶ The recapture rate for migrants was slightly worse (67%). Based on pre-migration survey, the missed migrants were similar to total sample in terms of sex composition, average measures of age, education attainment, household income, social support and subjective health, but a slightly higher CESD.

Table 1 Selection equation for missed cases^a

| Variable | Coeff. | t-Value |
|-----------------------------------|--------|---------|
| Intercept | 0.22* | 2.80 |
| Migration status (migrant = 1) | 0.07* | 2.78 |
| Gender (female = 1) | 0.02 | 0.99 |
| Residence (rural = 1) | -0.11* | -4.30 |
| Age | 0.00 | 1.29 |
| Education | 0.00 | 0.15 |
| Household income (in 10 thousand) | 0.01 | 1.88 |

^a 0 = success in follow-up,

1 = missing in follow-up

* Coefficient is significant at the .05 level using two-tailed t-test

To address possible biases that might result from attrition, we conducted a sensitivity analysis by regressing a dummy dependent variable (with a value of 1 indicating a respondent who was captured in wave 1 but was missed in wave 2 and 0 otherwise) on six socio-demographic variables measured at time 1 using a linear probability model (Berk 1983). The results (see Table 1) 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. The significant predictors of attrition will be used as control variables in our substantive analysis.

3.1 Analytical Strategy

We used a quasi-experimental design (Campbell and Stanley 1966) to measure the impact of the TGP on the involuntary migrants. Specifically, we gathered information pertaining to the social, economic, and mental and physical wellbeing of the forced migrants first before the move and then roughly 3 years after. Because changes in wellbeing can result from extraneous changes unrelated to the TGP, it is essential to control for such extraneous sources of change using a control group (Lieberman 1985). Because extraneous factors affect both the “experimental” group and the control group, their effects are neutralized and the effects of migration are singled out when changes in migrants’ wellbeing from time 1 to time 2 are measured using the corresponding changes for non-migrants as the benchmark (Campbell and Stanley 1966).

The difference between migrants and non-migrants in the amount of change in any outcome measure from time 1 to time 2, or group difference in the change score, can be estimated by the *difference-in-differences* (DID) estimator (Allison 1994; Halaby 2004):

$$DID = (\bar{Y}_{M2} - \bar{Y}_{M1}) - (\bar{Y}_{N2} - \bar{Y}_{N1}). \tag{1}$$

The DID estimator quantifies the migration effect, or the extent to which the average change in an outcome measure between time 1 and time 2 for migrants (M) exceeds the corresponding change for non-migrants (N). The estimator can be alternatively expressed as:

$$DID = (\bar{Y}_{M2} - \bar{Y}_{N2}) - (\bar{Y}_{M1} - \bar{Y}_{N1}). \tag{2}$$

In other words, the migration effect is measured by the extent to which the group difference in a post-migration measure exceeds the pre-migration difference. Because we are concerned primarily with the impact of migration experience, we excluded from the

analysis those who were designated to move but had not yet moved when the second survey was conducted.⁷

Unlike most migration studies which have relied solely on post-migration comparisons to ascertain migration impact, the prospective design used here enables us to control for pre-existing differences between groups in the outcome of interest. This design feature is extremely important given that migrants are known to be selective (Borjas 1987; Clampet-Lundquist and Massey 2008; Portes and Rumbaut 1996). Thus, unless pre-existing differences between migrants and non-migrants are taken into account (Lieberson 1985), post-migration differences between the two groups cannot be attributed to the process of migration itself.

3.2 Measurement

Using the conceptual framework discussed in the preceding section as our road map, we identified a set of indicators for each of the three aspects of wellbeing of interest. Specifically, we identified 12 indicators of economic wellbeing covering measures of income, employment, debts, possession of household appliances that reflect a high standard of living, housing conditions, and the extent to which the displaced are able to get easy access to things that are essential in modern life including seeing doctors, going to school, visiting relatives, shopping, and recreation using a reliable scale.⁸ Social wellbeing is indexed by Lin et al.'s (1999) perceived routine social support scale and several items which indicate how well the respondent adjusts socially. The mental wellbeing of the displaced is measured by the CES-D scale (Radloff 1977), a widely used survey-based measure of depression with well documented reliability and construct validity both in and outside of China (Hwang et al. 2007; Lin 1989; Vega and Rumbaut 1991).⁹ Because several items in the scale were worded positively, they were reverse coded before being summed with other items. The CES-D and the routine social support scale were translated into Chinese by two experienced researchers fluent in both languages following the translate-out-and-translate-back procedure. Finally, physical health is measured by respondent's subjective assessment and three indicators of self-reported physical problems.

4 Results

We present in this section the impact of the TGP as measured by the DID scores computed for a wide range of wellbeing indicators used in social sciences. Following our conceptual discussion in the earlier section, we grouped our indicators of wellbeing into three tables. Table 2 assesses the economic impact using 12 indicators of economic wellbeing. Table 3 measures social impact using the perceived routine social support scale and four indicators of social relationship. We examine mental and physical health impact in Table 4 using the CES-D scale and four indicators of physical wellbeing. We report two DID scores for each indicator. The unadjusted DID scores were computed using formula (1) given earlier and

⁷ We did include the designated migrants who had not moved as a separate group and compute the DID scores using non-migrants as the comparison group in an early version of the paper, all but one DID score were insignificant.

⁸ Our accessibility to essentials scale has a Cronbach's α of .84 for the pre-migration survey and .88 for the post-migration survey.

⁹ The CES-D scale has a Cronbach's α of .87 and .89 for the pre- and post-migration survey, respectively. The corresponding measures for the social support scale are .84 and .88.

Table 2 Adjusted DID scores measuring the TGP's economic impact on the displaced ($n = 770$)

| | | \bar{Y}_1 | \bar{Y}_2 | Migrants vs. non-migrants | | | P |
|-------------------------------------|-------------|-------------|-------------|---------------------------|----------------|---------------|-------|
| | | | | Differences | Unadjusted DID | Adjusted DID* | |
| Income, employment, and debt | | | | | | | |
| Total household income (¥) | Migrant | 11575.19 | 11765.74 | 190.55 | -2870.46 | -2265.40 | 0.10 |
| | Non-migrant | 10465.60 | 13526.61 | 3061.01 | | | |
| Total household debt (¥) | Migrant | 4105.07 | 10436.17 | 6331.10 | 4820.44 | 5490.70 | 0.001 |
| | Non-migrant | 2490.49 | 4001.15 | 1510.66 | | | |
| Unemployment (%) | Migrant | 1.67 | 2.62 | 0.95 | 0.10 | 0.21 | NS |
| | Non-migrant | 0.86 | 1.71 | 0.85 | | | |
| Possession of necessities | | | | | | | |
| Washing machine (%) | Migrant | 27.86 | 35.00 | 7.14 | 6.00 | 6.08 | 0.10 |
| | Non-migrant | 45.14 | 46.29 | 1.14 | | | |
| Air condition (%) | Migrant | 3.81 | 12.38 | 8.57 | -0.28 | 1.76 | NS |
| | Non-migrant | 17.43 | 26.28 | 8.85 | | | |
| Motorcycle (%) | Migrant | 12.38 | 17.38 | 5.00 | 2.71 | 2.80 | NS |
| | Non-migrant | 5.71 | 8.00 | 2.29 | | | |
| Refrigerator (%) | Migrant | 37.86 | 45.48 | 7.62 | 3.91 | 3.86 | NS |
| | Non-migrant | 52.29 | 56.00 | 3.71 | | | |
| Living conditions | | | | | | | |
| Per capita living space (sq.m) | Migrant | 30.73 | 32.85 | 2.12 | 0.92 | 1.80 | NS |
| | Non-migrant | 29.27 | 30.47 | 1.20 | | | |
| Own a house (%) | Migrant | 86.19 | 85.71 | -0.48 | 0.66 | 1.18 | NS |
| | Non-migrant | 93.14 | 91.14 | -1.14 | | | |
| Own a storied house (%) | Migrant | 51.67 | 76.43 | 24.76 | 25.90 | 26.40 | 0.001 |
| | Non-migrant | 80.00 | 78.86 | -1.14 | | | |
| Access to running water (%) | Migrant | 80.00 | 93.33 | 13.33 | 7.90 | 4.93 | NS |
| | Non-migrant | 79.71 | 85.14 | 5.43 | | | |
| Access to essentials | Migrant | 5.15 | 3.85 | -1.30 | -1.84 | -1.84 | 0.001 |
| | Non-migrant | 6.39 | 6.93 | 0.54 | | | |

NS not significant

* Controlling for variables that significantly affected attrition, plus age, gender, education, marital status, and CCP membership

the pre- and post-migration averages of the indicator of interest for the two groups. We also report adjusted DID scores, which control for the influences of attrition and several other variables including age, gender, education, marital status, and Chinese Communist Party membership. Because the unadjusted DID scores are more intuitive than the adjusted scores, we focus on the unadjusted scores. Each indicator is given a short label in the tables with detailed operational definitions provided in the Appendix.

Table 3 Adjusted DID scores measuring the TGP's social impact on the displaced ($n = 770$)

| | | \bar{Y}_1 | \bar{Y}_2 | Migrants vs. non-migrants | | | P |
|---------------------------------------------|-------------|-------------|-------------|---------------------------|----------------|---------------|-------|
| | | | | Differences | Unadjusted DID | Adjusted DID* | |
| Perceived routine social support (10 items) | Migrant | 32.77 | 32.31 | -0.46 | -1.38 | -1.61 | 0.05 |
| | Non-migrant | 34.06 | 34.97 | 0.91 | | | |
| Number of people contacted last week | Migrant | 3.55 | 3.29 | -0.26 | -0.11 | -0.14 | NS |
| | Non-migrant | 3.75 | 3.60 | -0.16 | | | |
| Frequency of interactions with relatives | Migrant | 23.95 | 14.05 | -9.90 | -0.70 | -1.46 | NS |
| | Non-migrant | 26.67 | 17.47 | -9.20 | | | |
| Rapport with neighbors (1 ~ 5) | Migrant | 4.10 | 3.89 | -0.21 | -0.25 | -0.25 | 0.001 |
| | Non-migrant | 3.95 | 3.98 | 0.03 | | | |
| Domestic conflict with spouse (%) | Migrant | 2.62 | 5.00 | 2.38 | 1.24 | 0.01 | NS |
| | Non-migrant | 2.57 | 3.71 | 1.14 | | | |

NS not significant

* Controlling for variables that significantly affected attrition, plus age, gender, education, marital status, and CCP membership

Table 4 Adjusted DID scores measuring the TGP's mental and physical impact on the displaced ($n = 770$)

| | | \bar{Y}_1 | \bar{Y}_2 | Migrants vs. Non-Migrants | | | P |
|-----------------------------------------|-------------|-------------|-------------|---------------------------|----------------|---------------|-------|
| | | | | Difference | Unadjusted DID | Adjusted DID* | |
| CES-D (20 items) | Migrant | 21.95 | 26.25 | 4.31 | 3.28 | 3.39 | 0.001 |
| | Non-migrant | 20.89 | 21.91 | 1.02 | | | |
| Subjective assessment of health (1 ~ 5) | Migrant | 3.48 | 3.19 | -0.29 | -0.24 | -0.22 | 0.01 |
| | Non-migrant | 3.38 | 3.33 | -0.06 | | | |
| Saw doctors last week (%) | Migrant | 22.67 | 34.69 | 12.02 | 5.69 | 5.59 | NS |
| | Non-migrant | 22.86 | 29.19 | 6.33 | | | |
| Took medicine last week (%) | Migrant | 36.43 | 49.88 | 13.45 | 3.62 | 2.15 | NS |
| | Non-migrant | 38.57 | 48.41 | 9.83 | | | |
| Injury or serious illness last year (%) | Migrant | 8.81 | 8.33 | -0.48 | 4.38 | 4.29 | NS |
| | Non-migrant | 10.29 | 5.43 | -4.86 | | | |

NS not significant

* Controlling for variables that significantly affected attrition, plus age, gender, education, marital status, and CCP membership

Our results show that the resettlement has had some negative impact on the economic wellbeing of the displaced. For example Although migrants and non-migrants both enjoyed some increase in total household income during the period, the increase for non-migrants

was much larger, resulting in a relative loss of 2,870 yuan for migrants. Controlling for other variables somewhat narrowed the gap but it was still marginally significant. In addition, the increase in household debts among migrant households exceeded their non-migrant counterpart by 4,820 yuan, a significant difference even after controlling for other variables. Although migrants experienced a slightly larger increase in unemployment than non-migrants during the period, the difference was insignificant.

Another way to gauge the project's economic impact on the displaced is to examine if they have experienced an improvement in standard of living. The standard of living is indicated by the percentage of households which own expensive durable goods such as a washing machine, air conditioning unit, motorcycle, and refrigerator. Although the percentage of households who owned such consumer durables has increased faster among migrant than non-migrant households, only one of the increase (owning a washing machine) was marginally significant.

Our third group of economic indicators focuses on living conditions. Our findings indicated that although migrants have a slight relative advantage over non-migrants as measured by changes in per capita living space, home ownership, and access to running water, none of these differences were statistically significant. However, migrants did enjoy a significant gain in owning a multi-storied house (adjusted DID = 26.40), an indication of good living in China.

Finally, the economic impact of the resettlement was gauged by discerning whether it has become easier or harder for the displaced to access essentials such as seeing doctors, going to school, visiting with relatives, shopping, and recreation. Our results indicate that compared to non-migrants, migrants had experienced a significant decline in being able to get easy access to such essentials.

Together, results presented in Table 2 showed that the forced relocation had affected the displaced both negatively and positively. The negative impact include relative changes in household income, debt, and access to essentials in daily life. On the positive side, a greater percentage of the displaced has become the owner of a washing machine and a multi-storied house during the period, changes often considered to be an improvement in living conditions in China.

We examined the social impact of the TGP on the forced migrants using two criteria: (1) perceived availability of routine social support, and (2) the quantity and quality of social connectedness. The results (see Table 3) show that migrants suffered a greater relative loss in routine social support than non-migrants. The scale yields an adjusted DID score of -1.61 , a reduction that is significantly greater for migrants than non-migrants.

In addition, we examined social wellbeing in terms of the quantity and quality of the respondent's social connectedness. Although we did not find significant differences between the two using quantitative indicators (i.e., the number of people contacted, and the frequency of interaction with relatives), migrants showed a significantly greater drop in rapport with neighbors (adjusted DID = $-.25$). Although our results also indicated a faster increase in the percentage of households with domestic conflicts among migrants than non-migrants, the difference was insignificant.

Finally, we turn to results assessing the mental and physical health impact of the forced migration (Table 4). There is overwhelming evidence suggesting that the level of mental distress has increased significantly among the displaced, and that the increase cannot be attributed to China's ongoing socioeconomic transitions and the socio-demographic characteristics of our respondents. The adjusted DID score indicates that the increase in the level of depression among the displaced during the period is 3.39 points higher than the corresponding change for non-migrants, a significant difference.

Finally, we measured the impact of the displacement on migrants' physical health using the subjective assessment of health and three indicators of poor health (i.e., saw a doctor last week, took medicine last week, and had an injury or serious illness last year). Our results indicated that migrants showed a significantly larger decline in subjective health (adjusted DID = $-.22$) than the comparison group. Although migrants also experienced a greater increase in the incidence of seeing doctors, taking medicine, and enduring an injury or a serious illness than non-migrants, none of the differences was statistically significant.

4.1 Overall Assessment of Impact

Although the preceding analyses provided detailed information regarding the specific impact of the displacement experience on migrants, it is possible that their overall assessment of the experience may be based on a complex weighting of these indicators that cannot be easily inferred from their responses to individual indicators. We explore this possibility by providing an additional analysis focusing on three overall measures of impact: (1) personal sacrifice, (2) willingness to move even if they did not have to, and (3) a belief that the TGP has done more harm than good.¹⁰

Because information about these measures was collected only from migrants, we excluded non-migrants from the additional analysis. Table 5 reports the wave-specific averages and the change score for each of the three overall measures. Table 6 examines individual variations in the change scores using a lagged-Y regressor model (Allison 1994).

The results (Table 5) show that a majority of these migrants felt that they had made a personal sacrifice for the TGP both before and after the move. The percentage of migrants with this sentiment has increased by 26.50 percentage points over the period. Furthermore, migrants who expressed a willingness to move if it were entirely up to them to decide decreased by 8.45 percentage points and those who believed that the TGP has done more harm than good to their family increased by 22.59 percentage points.

The average measures reported in Table 5 hide individual variations. Given that how migrants assess the migration experience depends on how well-adjusted they are, and that adjustment takes time, it stands to reason that migrants who have settled in the host community for a longer period of time should have a more positive assessment of the process than more recent migrants. Furthermore, their assessment should be affected by whether or not they have been compensated adequately for their losses by the government, among other factors. Results in Table 6 clearly support the first hypothesis. Thus, an increase in the length of stay in the host community significantly lowers the odds of negative assessment (i.e., personal sacrifice and TGP has done more harm than good to the family) and raises the odds of willingness to move. In addition, migrants who felt that they had not been adequately compensated are almost four times as likely as their counterparts to say that they have made a personal sacrifice. The adequacy of compensation failed to predict the other two measures, however. Among the other variables included in the models as controls, only urban residence has a consistent effect on the three outcome measures. The results indicated that those who were urban residents before the move were more inclined to both see the move as a personal sacrifice and feel that the TGP had done them more harm than good than their rural counterparts. This finding suggests that

¹⁰ The exacting wordings of the three questions are: (1) Do you feel that you have made a personal sacrifice for the Three Gorges Project? (2) If it were entirely up to you to decide, would you be (a) willing to move or (b) rather not move? (3) All in all, would you say that the Three Gorges Project has done (a) more harm than good, (b) more good than harm, or (c) roughly the same amount of harm and good, to your family?

Table 5 Migrants' overall assessment of the involuntary migration's impact ($n = 420$)

| | \bar{Y}_1 | \bar{Y}_2 | Differences* | P |
|-----------------------------------------|-------------|-------------|--------------|-------|
| 1. Personal sacrifice (%) | 57.55 | 83.45 | 26.50 | 0.001 |
| 2. Willingness to move (%) | 30.24 | 22.01 | -8.45 | 0.01 |
| 3. TGP has done more harm than good (%) | 26.90 | 46.90 | 22.59 | 0.001 |

* Controlling for variables that significantly affected attrition, plus age, gender, education, marital status, CCP membership, compensation, and length of time after migration

Table 6 Logistic regression analysis of migrants' overall assessment of the involuntary migration's impact ($n = 420$)

| | Odds ratio | | | | | |
|------------------------------------------|------------------------------------|-------|-----------------------------------|-------|------------------------------------------------------------|-------|
| | Personal sacrifice (sacrifice = 1) | P | Willingness to move (willing = 1) | P | TGP has done more harm than good (more harm than good = 1) | P |
| Intercept | | | | | | |
| Lagged Y | 1.57 | NS | 0.98 | NS | 2.27 | 0.01 |
| Time elapsed (month) | 0.96 | 0.01 | 1.07 | 0.001 | 0.95 | 0.001 |
| Inadequate compensation (inadequate = 1) | 3.92 | 0.001 | 0.76 | NS | 2.13 | 0.10 |
| Gender (female = 1) | 0.58 | 0.10 | 0.78 | NS | 1.32 | NS |
| Age | 0.98 | NS | 1.00 | NS | 0.99 | NS |
| Education | 0.91 | NS | 1.11 | NS | 0.95 | NS |
| Residence (urban = 1) | 2.88 | 0.05 | 0.09 | 0.001 | 3.99 | 0.001 |
| Marital status (married = 1) | 2.92 | 0.01 | 0.45 | 0.10 | 1.84 | 0.10 |
| CCP membership (CCP member = 1) | 1.90 | NS | 0.89 | NS | 0.83 | NS |
| LR χ^2 | 37.03 | 0.001 | 59.98 | 0.001 | 63.55 | 0.001 |

NS not significant

although it is more difficult for rural residents to relocate, rural migrants have little to lose but much to gain from the relocation given the wide urban-rural inequality in China in favor of cities (Roberts 1997). Our findings corroborated earlier findings (e.g., Li and Rees 2000; Li et al. 2001) that rural residents were more willing to move than urban residents as the move promised them a better living condition than the one they had.

5 Conclusion and Discussion

China's TGP has received widespread public attention as reflected by the amount of media coverage since its inception in 1994. However, journalistic coverage of the project's achievements and problems is often driven by the newsworthiness of the stories being reported instead of scientific motives. As a result, many important issues related to the TGP are left unaddressed.

One of the most important questions about the project is how it might affect the lives of more than one million Chinese who have been forced to relocate. This question is important not only because the wellbeing of an unprecedented number of involuntary migrants are at stake, but also because of its scientific value and its policy ramifications for future developmental projects in China and elsewhere.

In terms of the impact of the project on people who have been forced to move, our findings showed that despite the government's rosy promises to the displaced, many of the measurable impacts were negative. Except for some noticeable improvement in living condition, most of the indicators of wellbeing we included in this study pointed in a negative direction. For example, the displaced as a whole have experienced a decline in income and an increase in debt. Their new communities are found to be less accessible to essentials such as schooling, visiting with relatives, and shopping.

They also experienced some significant deterioration in social support and rapport with neighbors. The evidence of negative impact is most overwhelming when we focused on the mental and physical health of the displaced. Compared to non-migrants, migrants in our study have shown a significant increase in depression and a significant decline in self-rated health. Our findings pertaining to migrants' overall assessment of the migration experience also indicate a pervasive negative sentiment about the process and that such negative sentiment has grown rather than abated overtime.

In addition to providing systematic evidence to answer the question about the impact of the TGP, our study makes a major scientific contribution by successfully tackling a difficult research question. Scientifically, the TGP presents a rare opportunity for researchers to answer the challenging research question of how to accurately measure the impact of migration. Any accurate measure of Project-induced displacement's impact hinges on accurate measures of pre- and post-migration conditions. Accurate measures of pre-migration conditions are, in general, not available because most studies of migration are done retrospectively. Retrospective measures are often inaccurate not only because they depend on recalls, but also because those recalls are often contaminated by *ex post-facto* justifications (Campbell and Stanley 1966). In other words, pre-migration conditions have often been painted in a color according to the success or failure of the post-migration adjustments.

Because researchers are often unable to anticipate migration, a majority of migration studies have been done retrospectively and therefore inaccurately. Unlike other types of migration, the migration that is taking place in the Three Gorges is a planned process, which allows us to gather pre-migration information from designated migrants before they move. Thus, the TGP presents us with a rare opportunity to conduct a prospective study which greatly improves our ability to measure migration impact accurately.

The study also has important policy implications. As reported by several recent articles published by BBC and New York Times, China is in the process of building a series of dams in the upper reaches of the Yangtze River and three aqueducts to transport water from the water-rich South to the much drier North. These future projects are expected to displace a much larger number of people. Our findings about the negative impact of the Three Gorges project are likely to sharpen the awareness of the unintended consequences of even well-reasoned human projects and weaken the justifications for these future projects.

Appendix

See Table 7.

Table 7 Operationalization of Variables used in Tables 2, 3, 4

| Variables | Operationalization |
|-----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Income, employment, and "debt"</i> | |
| Total household income | What was your total household income last year? (yuan) |
| Total household "debt" | How much money your household owe? (yuan) |
| Unemployment | Were you ever out of work during the past year? (yes = 1; no = 0) |
| <i>Possession of necessities</i> | |
| Washing machine | Do your household possess any of the following items? (yes = 1; no = 0) |
| Air condition | |
| Motorcycle | |
| Refrigerator | |
| <i>Living conditions</i> | |
| Per capita living space | How big is your house in square meters? (square meters) |
| Own a house | Do you own the house? (yes = 1; no = 0) |
| Own a storied house | Is the house a multi-storied one? (yes = 1; no = 0) |
| Access to running water | Do your house has access to running water? (yes = 1; no = 0) |
| <i>Access to essentials</i> | |
| | How convenient is it for you to do the following activities in your current place of residence? (very convenient = 2; convenient = 1; not sure = 0; inconvenient = -1; very inconvenient = -2) |
| Seeing doctors | |
| Schooling | |
| Visiting relatives | |
| Shopping | |
| Recreation | |
| <i>Perceived availability of someone...</i> | Can you find someone... (yes = 4; yes, with difficulty = 3; don't know = 2; no = 1) |
| To borrow money | To lend you money to pay bills or help you get along? |
| To help with things around the house | To help in doing things around the house (cooking, cleaning)? |
| To help with daily routine when ill | To help with your daily routine if you were not feeling well? |
| To talk to when something bother you | To talk to about something that was bothering you? |
| To talk to when you feel lonely | For company when you felt lonely or just wanted to talk? |
| To give you a ride when needed | To give you a ride to someplace you had to go (shopping, post office)? |
| To watch your house while you were away | To watch your house while you were away? |
| To talk to about arguments you had with your spouse or closest friend | To talk to about arguments you had with your spouse or closest friend? |
| To make you feel good, loved, or cared for | To make you feel good, loved, or cared for? |
| To talk to about disappointments or bad days | To talk to about disappointments or bad days? |
| Perceived routine social support (10 items) | Perceived Routine Social Support scale (the sum of the 10 items) |
| <i>Social Relationship</i> | |
| Number of people contacted last week | Did you contact any of the following people during the past week? (yes = 1; no = 0) |

Table 7 continued

| Variables | Operationalization |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Frequency of interactions with relatives | (sum of “yes” for contacting friends, neighbors, colleagues, relatives, bosses, fellow villagers, others) How many times did you contact the following relatives who live in a separate house during the past month? |
| Rapport with neighbors | (sum of frequency count for contacting parents, adult children, siblings, other relatives) In general, how would you describe your relationship with your neighbors? (very good = 5; good = 4; neither good nor bad = 3; bad = 2; very bad = 1) |
| Domestic conflict with spouse | Did you fight with your spouse frequently during the past year? (yes = 1; no = 0) |
| <i>Mental distress symptoms</i> | How often do you... (often = 3; occasionally = 2; rarely = 1; never = 0) |
| Insomnia | Feel trouble in sleeping? |
| Lost of appetite | Feel like not eating? |
| Feeling lonely | Feel lonely? |
| Crying spells | Have crying spells? |
| Enjoying life | Feel enjoying life? |
| Feeling depressed | Feel depressed? |
| Bothered by things | Feel bothered by daily routines? |
| Everything was an effort | Feel that everything you do is an effort? |
| Feeling I as good as other | Feel that you are just as good as other people? |
| Trouble keeping my mind | Have trouble keeping your mind on what you are doing? |
| Feeling sad | Feel sad? |
| Feeling scared | Feel scared? |
| Didn't feel like talking | Feel not like talking? |
| Feeling happy | Feel happy? |
| Could not shake off the blues | Feel that you can not shake off the blues even with the help of family and friends? |
| My life was a failure | Think that your life has been a failure? |
| Could not get “going” | Feel that you can not get “going”? |
| Feeling hopeful for the future | Feel hopeful about the future? |
| Feeling others unfriendly | Feel that others are unfriendly? |
| Feeling others disliked me | Feel that others dislike me? |
| CES-D (20 items) | CES-D scale (sum of the 20 items) |
| <i>Physical wellness</i> | |
| Subjective assessment of health | In general, how would you rate your health? (very good = 5; good = 4; neither good nor bad = 3; bad = 2; very bad = 1) |
| Saw doctors last week | During the last week, did you go to see your doctor? (yes = 1; no = 0) |
| Took medicine last week | During the last week, did you take any medicine? (yes = 1; no = 0) |
| Injury or serious illness last year | Have you had any injury or serious illness during the past year? (yes = 1; no = 0) |

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