ABSTRACT

Title of Dissertation: INTERNAL MIGRATION, MARITAL DISSOLUTION, AND HEALTH IN CHINA 1989-2011: A LONGITUDINAL ANALYSIS

Xiayun Tan, Doctor of Philosophy, 2016

Dissertation directed by: Professor Alok Bhargava, School of Public Policy

Rapid economic growth and urbanization in China have been accompanied by increases in levels of internal migration, marital dissolution, and hypertension. Using longitudinal data from the China Health and Nutrition Survey, which covers more than 19,000 individuals from 1989 to 2011, this dissertation modeled the inter-relationships among internal migration, divorce, and adult health. First, random effects probit models showed that a longer migration period was associated with increased risk of divorce. Men had a rigid son-preference; having sons was associated more stable marriages for men but less so for women. The implementation of the 2001 Amendment to the Marriage Law increased marital dissolution in both urban and rural areas. Second, dynamic random effects models revealed that men self-reported better health statuses the longer their migration period was. Spousal absence as a result of internal migration drastically lowered

the self-reported health status of both men and women. Divorce lowered self-reported health status for both men and women although such impact was not found to be statistically significant. Third, dynamic models for systolic and diastolic blood pressures showed significantly higher hypertension risks for women the longer time they migrated. Divorce was found to have no significant impact on women's blood pressure but it improved men's systolic blood pressure. Fourth, higher Body Mass Index (BMI) was found to significantly increase both men and women's blood pressure. Men's hypertension risk significantly increased with higher alcohol consumption, while women's hypertension risk was significantly associated with smoking. Finally, implications of the findings for public policy and future research were discussed.

INTERNAL MIGRATION, MARITAL DISSOLUTION, AND HEALTH IN CHINA 1989-2011: A LONGITUDINAL ANALYSIS

by

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Dissertation submitted to the Faculty of the Graduate School of the
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Dedication

It doesn't matter where you go in life, what you do, or how much you have. It's who you have beside you.

This dissertation is dedicated to my husband Davey and my mom Yueping, the loves of my life. Thank you both for spoiling me by supporting all the decisions that I made and working together with me as a team through all the hard time.

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Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

1.1 Introduction

China has achieved impressive economic growth during the last three decades due to the rapid pace of industrialization and urbanization, facilitated by the creation of "Special Economic Zones." Large-scale rural-to-urban migration contributes to this economic progress, but also brought formidable challenges to the wellbeing of migrants and cohesion of their family structures. Investigations of this subpopulation have broader implications for the general population in China.

From the subpopulation perspective, rural-to-urban migration in China has led to the spatial separation of millions of married couples. It is common for one spouse (more often the husband) to seek employment in urban areas while the other stays behind to tend to agricultural work and family needs (Pan, Lu, & Zhang, 2012; Zuo, 2007). The "split-household strategy" enables rural families to boost household income and benefit from the rural-urban cost-of-living differential (Fan, 2008). This spatial separation, however, leads to lower levels of sexual intercourse, companionship, and everyday assistance. Spousal separation thus decreased the positive rewards of marriage and erodes marital stability. Couples' "value gap" increases if one partner migrates and the other one is left behind in rural areas, which might also cause conflicts between spouses (Shu 2007). To convey more elaborate information on the length of spousal separation I constructed a Migration Index, which summed the binary responses for whether the individual was away in the nine waves, and compiled an indicator of the number of months an individual spent working away from home, to convey more elaborate information on the length of spousal separations. Random

effects probit models found extended spousal separation to be a major reason for increasing divorce rate among internal migrants.

Rural-urban migrants have a higher risk of poor health than either their urban or rural counterparts. It is well documented that rural–urban migrants are vulnerable to infectious diseases, sexually transmitted diseases, mental health issues, and occupational injuries (Mou, Griffiths, Fong, & Dawes, 2013). On the other hand, whether China's internal migration serves as an independent contributor to non-communicable chronic diseases (NCDs) such as hypertension is largely unknown. The mechanisms and impacts of rural–urban migration on NCDs are complex and insufficiently documented. Many prior studies used self-reported health as a proxy for changes in physical health. In this dissertation, dynamic random effects models revealed that men reported better self-reported health status the longer their migration period was. Spouses' absence as a result of internal migration drastically lowered both men and women's self-reported health status. However, self-reported health status is a poor proxy because trends in self-reported health may not reflect subtle changes in underlying physical health (Wood, Goesling, & Avellar, 2007). In addition, people across different income groups and education levels have different expectations about and understanding of what a "good" health status should be (Graham, Zhou, & Zhang, 2015). In this dissertation, dynamic models for systolic and diastolic blood pressures showed significantly higher hypertension risks for women the longer time they migrated.

Analytical results at the subpopulation level suggested that more effective legislation reforms and public policies are warranted to improve the well-being of rural-urban migrants and their families. After all, the "split-household strategy" is often a suboptimal

and involuntary option for millions of migration families because of institutional barriers —such as Household Registration System (*hukou* system), restrained access to free education for migrants' children in the cities, and unequal employment opportunities. As a result of separate health insurance systems in rural and urban areas, rural-urban migrants are ineligible for the health insurance available in urban areas, although they are more vulnerable to health hazards and incur more medical debt.

A better understanding of the factors influencing marital dissolution and individual health is not only crucial to the subpopulation of internal migrants, but also important to the general population in China. China's overall divorce rate has increased dramatically since the late 1970s, and its hypertension prevalence is high while the overall hypertension control rate is substantially low.

Although the Chinese divorce rate is still considerably lower than that of other developed countries, such as the United States, China's crude divorce rate increased from 0.33 in 1979 to 2.7 in 2014. More than 3.6 million couples divorced in 2014, triple the number in 2002 (Ministry of Civil Affairs of the People's Republic of China, 2015). Divorce is a special public policy concern because it is often cited as an important cause of crime and delinquency (Popenoe, 1996). Divorce is also associated with economic hardship, social isolation, and risky health behaviors among both adults and children. However, the majority of theories and studies on causes and impacts of marital dissolution are based on Western cultures and populations in developed areas. In this dissertation, I propose comprehensive models to investigate the causes and impacts of divorce in the Chinese context, which take into account both long-lasting cultural traditions and modern socioeconomic developments.

Many studies have discussed son preference as a common cultural and social tradition rooted in Chinese Confucian thought. Confucian tradition stresses the importance of carrying on family line and surname. This task can only be accomplished through male progeny. Marriages are often in trouble if they do not produce a son after sufficiently long periods (Zeng, 1995). In addition, Chinese couples prefer boys for practical purposes such as for future care in old-age. Given the country's one-child policy, which places strict limitations on the number of births, if a wife does not give birth to a boy, it may cause conflicts among couples (Xu, Yu, & Qiu, 2015). The gender composition of surviving children (Muhuri & Preston, 1991; Bhargava, 2003a) is likely to have differential effects for men and women's chances of marital dissolution. In particular, men in an unhappy marriage with a first-born daughter might be more inclined to divorce and re-marry with the expectation of producing a son. Such asymmetries have been partially addressed in previous research (Xu, Yu, & Qiu, 2015) and were systematically investigated in this dissertation. Random effects probit models for divorce risks showed that men had rigid son-preference and having sons implied more stable marriages for men. It was less so for women.

Institutional barriers to leaving the marriage have changed recently in China. In the 1960s and 1970s, restrictive legal and administrative divorce procedures were designed to preserve the family because the newly established Chinese government believed that family was the fundamental unit of society and divorce would threaten the stability of the country (Zeng, Schultz, Wang, & Gu, 2002). In rural areas, the village generally supplies land and homestead through the husband's family, with women forfeiting these property rights after divorce. Chines, and especially Chinese women, thus find it difficult to divorce

despite being in unhappy marriages. Things, however, have started to change in the 1980s (Miller et al., 2013). The Chinese government has substantially changed the structure and function of Chinese families through various legal reforms to promote individual marriage choice and increase the equality of women in families and society at large (Hershatter, 2004; Das Gupta, 2010). Great efforts to protect divorced women's rights were made in the 1980 New Marriage Law. The 1985 Inheritance Law sought to counter gender discrimination in inheritance (Das Gupta, 2010). The 2001 Amendment to the Marriage Law specified property division in greater detail, reinstating the rural women's rights to land and housing upon divorce. It made unilateral divorce possible in the case of domestic violence and extra-marital relationships, which are the grounds used mainly by women. Considering the more liberal legal climate for divorce and greater financial protection for women, random effects probit models for divorce risks revealed that implementation of the 2001 Amendment to the Marriage Law increased marital dissolution in both urban and rural areas.

Models for systolic and diastolic blood pressure levels of men and women can provide insights into the effects of divorce on individuals' health. Using blood pressure as the health outcome of divorce is vital in the Chinese context. Fu (1988) and Chui (1994) posited that Chinese marriages were of high stability but low quality. Chen, Liu, Vikram, and Guo (2015) presumed that those who were married in rural China made up a higher proportion of those who were in unhappy marriages but stayed in the marriage due to strong and deeply-rooted social stigma towards divorce in Chinese culture. In addition, despite the dramatic increase of divorce rates in China, its universal divorce rates are still comparatively lower than other developed counties. In 2011, the divorce to marriage ratio

was 22 for China, 53 for the United States, and 51for Russia (United Nations Statistical Division, 2011). Blood pressure levels are affected by domestic tension, and high marital quality is associated with lower ambulatory blood pressure (Holt-Lunstad, Birmingham, & Jones, 2008). It's plausible that couples in an unhappy marriage could experience elevated blood pressure levels that may be reduced by amicable separation, so that escaping from a long-term marriage of poor quality and full of tension might imply some sort of relief (Wheaton, 1990; Williams, 2003). In addition, obesity rate increased in China due to changes in dietary patterns and lifestyles (e.g., Whang et al., 2012), and that needs to be taken into account in the models. Also, a high proportion of men smoke cigarettes and consume alcohol. These factors can also increase blood pressure levels. Thus, comprehensive dynamic models for systolic and diastolic blood pressures can provide insights into the effects of divorce. Estimation results showed that divorce had no significant impact on women's blood pressure, but it improved men's systolic blood pressure. Higher Body Mass Index (BMI) was found to significantly increase both men and women's blood pressure. Men's hypertension risk significantly increased with higher alcohol consumption, while women's hypertension risk was associated with smoking.

Modeling the inter-relationships among internal migration, divorce, and measures of health status requires a long time frame since the effects of explanatory variables on outcomes are likely to be gradual and there is considerable heterogeneity in the circumstances facing couples. The availability of nine waves of data from the China Health and Nutrition Surveys (CHNS) for 1989-2011 provides a unique opportunity to investigate several relationships. It is, however, important to tackle at least three sets of methodological issues for drawing robust inferences.

First, estimation of probit models that control for unobserved heterogeneity via random effects (Vella and Verbeek, 1999) can provide useful insights into the factors underlying marital dissolution in China. One of the major advantages of random effect probit modeling in comparison with simple probit modeling is its ability to distinguish two levels (i.e., within- and between-individual) of heterogeneity in estimating probability of divorce shaped by migration level. With time-varying covariates, the models captured the time-dependence in relationships.

Second, while it is important to explain individuals' chances of internal migration by measures of health, previous researchers have primarily estimated cross-sectional models (e.g., Tong and Piotrowski, 2012). Such models cannot account for the dynamics in the inter-relationships between outcome variables. Moreover, couples' health status is likely to be influenced by the length of separation periods and can introduce feedback effects ("simultaneity") into the relationships. It is therefore important to employ econometric methods for longitudinal data (Bhargava & Sargan, 1983) for modeling the effects of internal migration on individual well-being in China.

Third, although some scholars have theorized and found a greater association between marital distress and health among women than men (Beach, Katz, Kim, & Brody, 2003; Fincham, Beach, Harold, & Osborne, 1997; Miller, Mason, Canlas, & Wang, 2013), the majority of studies have found no gender differences (Sandberg, Yorgason, Miller, & Hill, 2012; Whisman, 2007; Whisman & Uebelacker, 2009). Likelihood ratio tests rejected the null hypothesis that the model parameters were constant across the gender groups and geography regions for both divorce and health models in this dissertation. Hence estimation results were reported separately for men and women, rural and urban, reflecting an

imbalanced evolving pace by gender, geography and economic development phase in China.

This dissertation is organized in three chapters. Chapter 1 provides an overview of internal migration, marital dissolution, and hypertension in China. Motivations behind the current study are explained in Section 2. In Section 3, theories and conceptual framework are laid out and applied to explain marital dissolution and the connection between divorce and health in China; the research hypothesis is proposed in this section. In Section 4, the scope of this dissertation and its contributions are described.

Chapter 2 presents comprehensive analyses of the nine waves of longitudinal data from the China Health and Nutrition Surveys conducted from 1989 to 2011, focusing on the effects of internal migration, son preference, and the 2001 Amendment to the Marriage Law on the probabilities of marital dissolution. I describe the data and measures of explanatory and outcome variables. Empirical methods and econometric methods are also explained. Estimation results from random effects probit models for divorce risks are presented and discussed from statistical and public policy perspectives. I then examine the potential bias brought by attrition and missing values in the survey and conclude that no severe bias is evidenced.

Chapter 3 is dedicated to investigation of dynamic inter-relationships among internal migration, divorce, and adult physical health. I describe the data and measures of explanatory and outcome variables. Empirical models and econometric methods are then introduced. After carefully analyzing estimation results from dynamic random effects models for self-reported health status, diastolic, and systolic blood pressure, I discuss the estimation results and their value in informing more effective public policies.

1.2 Background and Motivations

1.2.1 Internal Migration in China

Internal migration started to accelerate in the 1980s after China initiated its economic reforms in 1978 (Mou, et al., 2013). While only 21.1% of the country lived in urban areas in 1982, about 45.7% of China's population was living in cities by 2009 (Peng, 2011). An average of 15 million rural–urban migrants moved annually from their villages to cities from 2000 to 2010 (Gong, Liang, & Carlton, 2012). Rural-urban migrants are referred to as the "floating population." (Zhang, 2001) There were an estimated 147 million migrants in 2005 and this figure reached 253 million in 2014, according to the National Health and Family Planning Commission. The floating population now accounts for 18.5% of the national population and is predicted to increase to 291 million by 2020 (National Bureau of Statistics in China, 2014).

Massive rural-to-urban migration in China has led to spatial separation of millions of married couples (Chen, Liu, Vikram, & Guo, 2015). It is common for one spouse (more often the husband than the wife) to seek employment in urban areas while the other stays behind to tend to agricultural work and family needs (Pan, Lu, & Zhang, 2012; Zuo 2007). Around one-half of the married migrants did not live with their spouses and children in 2009 (Pan, Lu, & Zhang, 2012; Solinger, 1999). Some scholars see this unique 'split-household strategy' as a household decision that enables rural families to boost household income and benefit from the rural-urban cost-of-living differential (Fan, 2008), while others see it as a suboptimal option considering various institutional barriers, among which the foremost is the Household Registration System (known as *hukou* system in Chinese).

Since the 1950s, Chinese authorities have restricted the geographical mobility of the population through the *hukou* system. Under the *hukou* system, each Chinese resident was assigned to a particular place of residence and was categorized as either a rural or urban resident. Rural residents were not allowed to move to cities, and urban residents were not allowed to move between cities (Chan, 1994; Cheng & Selden, 1994). In addition, social resources such as access to jobs, housing, land, health care and children's schooling were also strictly designated according to the *hukou* categories. Since the market economic reforms in 1978, China has loosened its restriction on internal movement to meet the growing job market in the urban areas. For instance, rural-urban migrants are permitted to work in towns or cities on the basis of "temporary residence permits" (*zanzhu zheng*) without obtaining urban *hukou*. However, major functions of the *hukou* system remain intact and most migrants can't change their *hukou* status. For example, rural-urban migrants have to pay a lot extra for their children's education in the cities while tuition is free for children with urban *hukou*. This payment is often beyond the migrants' affordability. Some better paid job opportunities are still exclusive to residents with urban and local *hokou*. Rural-urban migrants generally concentrate in low-paying and labor intensive labor markets.

Health insurance and health care is one of the greatest barriers for rural-urban migrants and one of the formidable policy challenges for the Chinese government. Currently, China has three primary health insurance programs, namely, the Urban Employee Basic Medical Insurance (UEBMI) for the urban employed, the Urban Resident Basic Medical Insurance (URBMI) for urban residents, and the New Cooperative Medical Scheme (NCMS) for rural residents. On one hand, without a change in *hukou* status, the vast majority of migrants do

not qualify for public medical insurance and assistance programs in urban areas (Tong & Piotrowski, 2012). On the other hand, NCMS focuses on the coverage of in-patient care (rarely covers out-patient expenses), with different but generally lower reimbursement rates (higher rates of 35%-60% at rural township health care centers and lower rates of 25%-40% at county-level facilities), and limited "portability."(Qiu, Caine, & Yang, 2011) Migrants have to seek medical service at designated facilities within the county of their *hukou* registration, which often are county-level hospitals and township health care centers, in order to get better reimbursement. Reimbursement is discounted sharply if they use services provided outside of their home counties, and the reimbursement application process is complicated.

Medical debt can prevent rural households from moving out of poverty or can drive families into poverty (Gustafsson & Li, 2003). Health insurance is of particular importance for rural-urban migrants, considering they are already at a higher health risk than their urban and rural counterparts. It is well documented that rural–urban migrants are vulnerable to infectious diseases, sexually transmitted diseases, mental health issues, and occupational injuries (Mou et al., 2013). They have a higher incidence of infectious diseases (e.g., malaria, hepatitis, typhoid fever, respiratory infections and measles infections) due to unfavorable working and living conditions, low awareness of disease prevention and lower immunization status (Fu, Xu, & Liu, 2010; Mou, Griffiths , & Fong, 2010; Abdulraheem, 2007). Depression, depressive symptoms and insomnia are common among Chinese migrants and their families (Mou, Cheng, & Griffiths, 2011; Qiu, Caine, & Yang, 2011; Hu, Mason, & Song, 2007). With many migrants working in mining, manufacturing and construction (Chan & Griffiths, 2010), environmental hazards such as

chemicals, toxic substances, noise, dust and poor ventilation contribute to occupational damage such as acute/chronic poisoning, cancer, hearing disorders, injury, disability or even death (Gransow, 2012; Liang & Xiang, 2004; Mou, et al., 2009). Evidence suggests additional health inequities among migrant women in China. They are less likely to receive prenatal care services (Liu & Lv, 2011; Zhao, Huang, & Yang, 2012) and regular gynecological check-ups (Chen & Zheng, 2005; Lan, et al., 2004) than permanent female residents. Smith-Greenaway and Madhavan (2015) argued that migrants' health disadvantages should be short-lived and wane over time. The longer migrating women have lived in the destination community, the less disruption of migration on women's economic and social circumstances, and more improvement of their health-seeking behaviors (Brockerhoff, 1994).

The complex mechanisms and impacts of rural–urban migration on non-communicable chronic diseases (NCDs) are less documented. Evidence shows that urbanization is estimated to raise the age-standardized rate of coronary heart disease incidence by 73–81 per 100 000 (Chan, Adamo , & Coxson, 2012), and migratory experience increases the risks of having a higher age-related rise in blood pressure (He , Klag, & Whelton, 1991). Migrants are found to have higher smoking prevalence post-migration compared with pre-migration. Migratory lifestyles were found to increase smoking initiation (Yang, Wu, & Rockett, 2009). Stress (Cui, Rockett, & Yang, 2012), poorer mental health and time spent in the city (Mou, Fellmeth, & Griffiths, 2013) have been explored as risk factors for increased smoking. Migrants are reported to have elevated alcohol consumption (Lin, Li, & Yang, 2005).

Nevertheless, whether China's rural–urban migration serves as an independent contributor to NCDs such as hypertension is largely unknown (Gong, Liang, & Carlton, 2012). Very few empirical studies have successfully tracked the progression of hypertension in China, particularly in cohorts of rural–urban migrants. Therefore, it is still difficult to make an explicit causal inference between internal migration and chronic disease risks in China at this stage. Many scholars in chronic disease prevention research in China have focused on ageing and its effects on incidence and prevalence of disease, whilst the rural–urban movers have been neglected or, if studied, attention is often drawn to their psychological problems. Further efforts built on longitudinal follow-up design and appropriate data collections are warranted. This will provide valuable information to policy and decision makers of the Chinese governments, at the central or local level, in sending or receiving regions, on how to further reform the current *hukou* system and/or health insurance schemes in order to improve overall population health status, increase social inclusion and decrease inequality and poverty, with particular attention paid to the marginalized and vulnerable, yet continuing to increase, rural-urban migrants.

1.2.2 Marital Dissolution in China

China's divorce rates have increased dramatically since the late 1970s with the rapid economic growth and significant socio-demographic changes. China's crude divorce rate, measured by number of divorces per 1000 population, increased from 0.33 in 1979 to 2.7 in 2014. There have been steady increases in the divorce rate in the last decade. More than 3.6 million couples divorced in 2014, triple the number in 2002 (Ministry of Civil Affairs of the People's Republic of China, 2015). Figure 1 shows the continuous increase of crude divorce rate in China from 1987 to 2013.

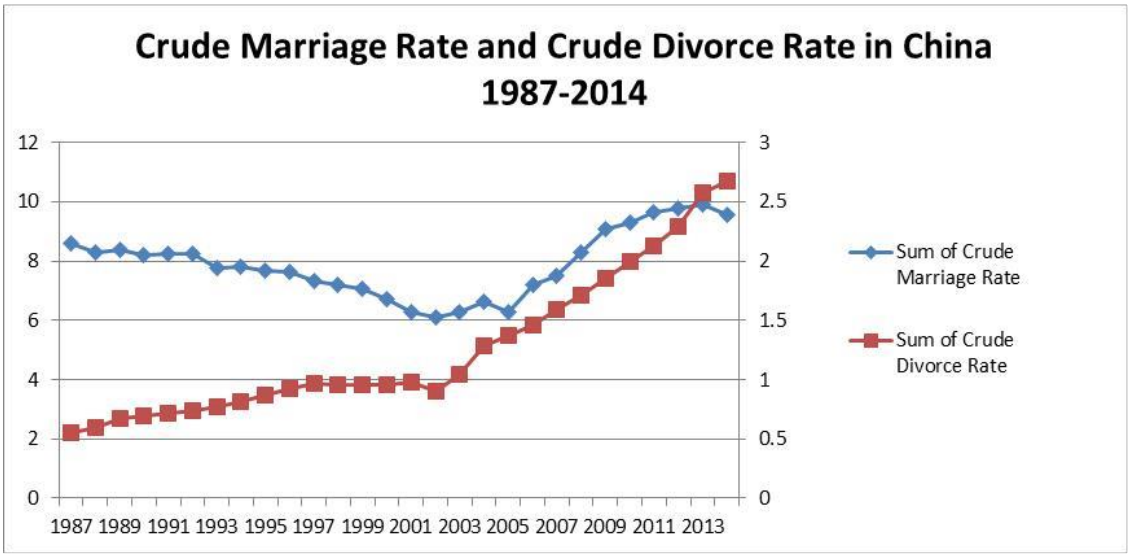

Figure 1: Crude Marriage Rate and Crude Divorce Rate in China 1987-2014 [1]

Despite the fact that the Chinese divorce rate is still considerably lower than in other developed countries such as the United States (See Figure 2: Divorce rates around world 2014) , China offers a compelling and unique context in which to study the marital dissolution phenomenon and to test the external validity of various marriage formation and dissolution theories since the vast majority of studies have been based on western cultures and populations in developed areas. In addition, this dissertation can further contribute to the marriage and living-arrangement literature and further investigate the particular impact of the split-family strategy, where couples are married but live separately, on marital dissolution risks and on couples' health status.

[1] Source: Ministry of Civil Affairs of the People's Republic of China

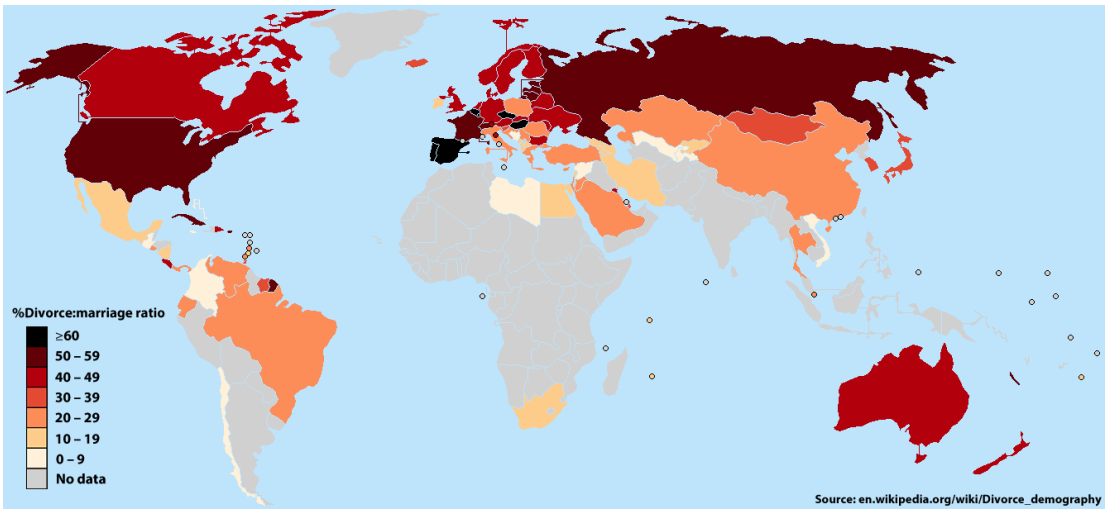

Figure 2: Divorce rates around world 2014[2]

Furthermore, investigating the causes and impact of this emerging population demographic phenomenon is of particular interest in Chinese society in its transitioning phase, where there is great collision between long-lasting cultural and social traditions (such as son preference and social stigma towards divorce) and socioeconomic development and institutional reforms (such as increased women's education and new marriage laws). The key is to ask the right research and policy questions. Rather than blindly asking "what causes marital dissolution" or "whether divorce has a positive, negative or neutral impact on adult health", researchers and policy makers need to strip down to questions such as "what causes marital dissolution, and for whom" (i.e., do causes for divorce differ by gender, and/or by rural/urban residential status?); and "how will marital dissolution affect adult health, on which particular health indicator, within what time framework, and for whom" (i.e., will marital dissolution affect adults' hypertension in the short run or/and long run, and does this impact differ by gender?) Answering such

[2] Source: Engel, 2014

questions helps to inform the social policy debates between those who see divorce as a beneficial alternative and a necessary result of social and individual development (and thus no stringent administrative processes or policies are needed to curb the divorce rate) and those who see divorce as a major social problem (thus rigorous policies need to be adopted to avoid the potential negative impact of marital dissolution on individuals, households, and society). Divorce among parents is a special policy concern because single motherhood (or absent fatherhood) is often cited as an important cause of crime, delinquency, and community decline (Popenoe, 1996). At the individual level, divorce is associated with economic hardship, social isolation, and risky health behaviors among both adults and children (Morrison & Ritualo, 2000; Peterson, 1996). Divorce has long been linked to physical and emotional health problems (Avison, 1999; Simon & Marcussen, 1999).

Taken together, factors contributing to increases in Chinese divorce rates are not well understood. Very few empirical studies based on statistical analyses of individual or household level data have been published on the association among various sociodemographic factors and divorce risks in China. There is also a big gap in the literature on both short term and long term impacts of divorce on physical health of adults. Gaps in the literature are partly due to the scarcity of data on marriage and divorce history in sufficiently large samples to clarify the multiple factors affecting divorce (Zeng, Schultz, Wang, & Gu, 2002). Advanced econometric analysis and comprehensive modeling are necessary to tackle potential feedback effects.

1.2.3 Hypertension in China

Cardiovascular disease (CVD) is the number one cause of death worldwide (Zorzi, Migliore, & Elmaghawry, 2013) and in China (Peters & Trummel, 2003). CVD accounted for more than 30% of adult deaths in China (Lewington et al., 2016) in 2010. Hypertension is the leading preventable risk factor for CVD and premature death (He, 2016), and uncontrolled hypertension has been estimated to cause 750000 CVD deaths annually in China in 2010 (Lewington et al., 2016).

An increasing prevalence of hypertension has been reported in successive national population surveys of hypertension in China during the last 30 years. The prevalence of hypertension was 5.1% in 1959, rising to 7.7% in 1979, 13.6% in 1991, and 18.8% in 2002 (Li et al., 2012). While there has been no large-scale nationwide survey on hypertension since 2002, several studies attempted to ascertain the current prevalence of hypertension in the Chinese general population (Ma, Mei, Yin, Yang, & Rastegar, 2013). The China National Diabetes and Metabolic Disorders Study reported an age-standardized prevalence of hypertension of 26.6% in 2007–2008 (Gao et al., 2013). Hypertension prevalence was estimated at 29.6% by the China National Survey of Chronic Kidney Disease in 2009–2010 (Wang et al., 2014). In 2010, the prevalence of hypertension increased to 33.6% or 335.8 million Chinese adults based on the China Non-communicable Disease Surveillance (Li et al., 2012; Xu et al., 2013). The most recent survey by Lewington et al (2016) found a prevalence level of 32.5%. Differences in the prevalence of hypertension among these studies might be partially due to measurement methods.

China has higher hypertension prevalence than other parts of Asia and it is now comparable to that of Western populations (Lewington et al., 2016). The levels of diagnosis, treatment, and control of hypertension in China, however, are substantially lower than those achieved in many high income countries. According to Lewington et al (2016), of those patients with hypertension, 30.5% had a formal diagnosis from a physician, of whom only 46.4% were being treated. Thirty percent had their hypertension controlled, leading to an overall control rate of 4.2% in the studied cohort and causing substantial premature deaths. In contrast, in Europe, Japan and North America, for example, more than 80% of hypertensive individuals are aware of their hypertension, more than 80% are receiving anti-hypertensive treatment and more than 60% are controlling their hypertension well (Guo, He, Zhang, & Walton, 2012; Wilkins et al., 2010; Guessous et al., 2012; Feng, Pang, & Beard, 2014)

In 2013, the World Health Assembly set voluntary goals for non-communicable diseases control, including a 25% reduction in the prevalence of elevated blood pressure by 2025 (Lewington et al., 2016). The Chinese government targeted a reduction of non-communicable disease mortality by one third as one of its 2030 sustainable development goals (UNDP, 2015). Despite the fact that a few campaigns against hypertension had been launched in China, and there had been increasing coverage and utilization of healthcare resources in China from 2003 to 2011 (Wang et al 2014), Lewington et al (2016) found no regions or subgroups had satisfactory BP control. Given that hypertension can be prevented and controlled at low cost (Lu et al., 2012; WHO, 2013; Mendis et al., 2010), the main stumbling block in the effective management of hypertension in China is how to identify and reach the many hypertensive individuals who are unaware of their hypertension,

especially those who do not present for regular health checkups (i.e., the rural-urban migrants) (Feng, Pang, & Beard, 2014). One aim of this dissertation is thus to examine the factors that increase hypertension risks, some of which have been discussed extensively in the health literature (such as education level, BMI, drinking and smoking) while others have received little attention in the Chinese context (such as internal migration and divorce). Providing reliable and more detailed information about hypertension risks is essential to the development of identification strategies and health policies for prevention and control of this condition, with special attention paid to the socioeconomically disadvantaged rural-urban migrant subpopulation in China. In addition, observations on the behavioral determinants of hypertension (such as smoking, alcohol consumption and BMI) can help government and other stakeholders to identify modifiable risk factors and achieve hypertension risk reduction through either institutional-level interventions or individual-level health promotion (WHO, 2008; Di Cesare et al., 2013)

1.3 Theories and Literature Review

Theories and studies of marriage have been developed and tested on Western cultures and developed countries. As such, China serves as a compelling context to test the generality and external validity of these theories and conceptual frameworks. This section introduces the Social Exchange Theory as a means of understanding how and why a relationship continues or dissolves. This theory is then applied to explain marriage stability in China, taking into account both long-lasting cultural traditions and modern socioeconomic development. Second, various models and conceptual perspectives of the connections between marriage and health are closely studied. Generality of the Resource

Model and the Stress Model are tested in the Chinese context. Third, the scope of this dissertation is carefully defined, and its contributions to the current literature, conceptual frameworks, econometric analytical techniques, and policy analysis are discussed.

1.3.1 The Divorce Model

1.3.1.1 Theory for marital dissolution

Attractions, barriers, and alternatives are three key components of the Social Exchange Theory, which has been frequently applied to understand why relationships form, continue, and dissolve (Homans, 1950; Thibaut & Kelley, 1959). Attraction to a spouse is related to the positive rewards received from the relationship (such as love, sex, companionship, emotional support and everyday assistance) minus the relationship's negative costs (such as verbal and physical aggression). Barriers, which must be overcome to successfully dissolve a marriage, include moral or religious values, concerns about social stigma, legal restrictions, and financial dependence. For example, couples might decide to stay together despite having a troubled relationship because divorce is against their religious belief. Alternatives provide the opposite effect, allowing people to end the current relationship because they believe that a different relationship would bring greater rewards. Correspondingly, unhappily married individuals may remain married if they don't see viable alternatives to the marital dissolution (Amato & Hohmann-Marriott, 2007).

Sabatelli and Ripoll (2004) applied the Social Exchange Theory to explain how recent historical, economic and cultural changes in American society affect marital stability. For example, evidence suggests an increasing expectation from marriage in recent decades. Recent surveys indicate that college students value marriage because they expect it to

provide a deep source of love and emotional fulfillment (Barich & Bielby, 1996; Buss, Shackelford, Kirkpatrick, & Larsen, 2001), in contrast to the surveys in the 1950s and early 1960s that found that college students valued marriage because it provided a home, an economically secure lifestyle, and the opportunity to raise children. Marriages not able to meet these personal needs collapse despite other benefits marriages provide.

Barriers to leaving marriage have also changed in American society. Attitude surveys reveal a decline in religious influences on peoples' beliefs about the nature of marriage and its importance as a religious commitment (Glenn, 1987), and social acceptance of divorce increased between the 1960s and the 1990s (Thornton & Young-DeMarco, 2001). Moreover, greater participation in the paid labor force made married women less economically dependent on their husbands and hence made it easier for women to leave unhappy marriages (Nock, 2001). Finally, the laws regulating marital dissolution became more lenient throughout the 20th century (Amato & Irving, 2005). Taken together, obtaining a divorce is thus less stigmatizing, costly, and time-consuming today than in the recent past (Amato & Hohmann-Marriott, 2007). Peoples' perceptions of marital alternatives are also likely affected by social change. Many married people may see being single as a viable and attractive alternative to being unhappily (or even moderately happily) married (Previti & Amato, 2003).

1.3.1.2 Theory generality in the Chinese context

Social Exchange Theory can be applied to examine factors influencing Chinese divorce rates as there have been great historical, economic and cultural changes in recent decades.

Internal Migration

High volumes of internal migration accelerate the diffusion of higher expectation and values related to marriage and marital attraction from the urban to the rural areas. In addition, couples' spatial separation, a dominant form of split households in the 1980s and 1990s, led to lower levels, or even total lack, of sexual intercourse, companionship, and everyday assistance, further decreasing the positive rewards marriage should have brought and thus eroded marital stability, compared to couples who spent more time together. Due to the lack of reliable and sufficiently large data sets on the giant "floating population," there have been very few empirical papers investigating how migration affects divorce rates. The existing literature on these issues is mostly in the Chinese language using descriptive and qualitative methodology. In a survey of 966 rural-urban migrants in Anhui Province, a top rural-urban migrant sending region, Shu (2007) concluded that the major reasons for the increasing divorce rate among rural-urban migrants were, first, women's financial independence had increased and their traditional views on the purpose of marriage had changed. Second, migrants thought the quality of marriage was more important than the traditional filial piety that drove them to obey the tenets of arranged marriages. Third, prolonged spousal separation resulted in the lack of sexual intercourse and increased the chances of extramarital affairs. Fourth, a couple's value gap increases if one partner

migrates and the other one is left behind in rural areas. I therefore propose the following hypotheses:

Hypothesis 1: Longer spousal separation is associated with higher divorce rates.

Son Preference

The interplay of culture, state, and political processes generated uniquely rigid patriliny and son preference in China (Das Gupta, 2010). Many studies have discussed son preference as a common cultural and social tradition that is rooted in Chinese Confucian thought and affects marriage. Confucian tradition stresses the importance of carrying on the family line and surname, a task that can only be accomplished through male progeny. Institutionally, political and administrative systems used patrilineages to organize and manage Chinese citizens as early as the pre-modern era. On the individual level, Chinese couples prefer boys for practical purposes as well, such as for future care in their old-age due to the lack of or unsatisfactory level of retirement benefits and social welfare system.

Marriages are often in trouble if, after sufficiently long periods, they do not produce a son, which is the key to continuing the family line (Zeng, 1995). Based on In-Depth Fertility Surveys in Shanghai, Shaanxi and Hebei in 1985, Zeng et al. (2002) found that the traditional son preference does not have significant effects on chances of divorce among women who have one or two children. However, the risk of divorce of women who have three or more daughters without a son was 2.2 times higher than that for women who have three or more children with at least one son. In a more recent survey conducted by the Gallup Organization in 1997, sixteen countries on four continents were asked about people's preference for sons versus daughters. While China was not included in this survey,

other traditionally male-centric societies such as Taiwan showed strong preferences for boys; boys were preferred by a 3:1 margin (Gallup Organization, 1997). To people with rigid son preference, according to the Social Exchange Theory, remarriage might even become a strong alternative in order to have another opportunity for producing boys.

Some scholars suggest that China may start to experience reductions in son preference since industrialization and urbanization are well underway, and the Chinese government has adopted strong public policies, vigorous media campaigns and legislation to counter gender inequalities (Das Gupta 2010; Das Gupta, Chung, & Li, 2009; Chung & Das Gupta 2007). Reduction of son preference may be more significant in urban areas, while the traditional concept of son is still likely to play an important role in isolated rural areas (Xu, Yu, & Qiu, 2015).

In addition to the imbalanced pace of change due to geography and economic differing development, gender may also play a role. Some studies argue that women's preferences for sons may even be stronger because a son will bring them more respect from their husband and in-laws, as well as increased support in their old age (Sun & Zhao, 2014), while Dahl & Moretti (2004) document that this preference for sons seems to be largely driven by fathers, with men reporting they would rather have a boy by more than a 2:1 margin. Long-lasting son preference, combined with one-child policy, is likely to affect the probability of marital dissolution. In particular, men in an unhappy marriage with a first-born daughter might be more inclined to divorce and re-marry with the expectation of producing a son. In view of the likely impact of son preference on divorce risks, I investigate the following hypotheses:

Hypothesis 2: Having more sons decreases divorce risks.

Hypothesis 3: Son preference affects divorce risks differently by regions.

Hypothesis 4: Son preference affects divorce risks differently by gender.

Marriage Law

Barriers to leaving the marriage have changed recently in China. Restrictive legal and administrative divorce procedures were designed to preserve the family in the 1960s and 1970s, because the newly established Chinese government believed that family was the fundamental unit of society and divorce would threaten the stability of the country (Zeng, Schultz, Wang, & Gu, 2002). In rural areas, the village generally supplies land and homestead through the husband's family, and women forfeit these property rights after divorce. Chinese thus found it difficult to divorce despite being in unhappy marriages, especially for women. Things have started to change since the 1980s (Miller et al 2013). There has been a rising social acceptance of divorce, especially in the cities (Liao & Heaton, 1992). The Chinese government has substantially changed the structure and function of Chinese families through various legal reforms to promote individual marriage choice and to increase the equality of women in families as well as in society (Hershatter, 2004; Das Gupta, 2010). Great efforts to protect divorced women's rights were made in the new 1980 Marriage Law and the 1985 Inheritance Law sought to counter gender discrimination in inheritance (Das Gupta, 2010). The 2001 Amendment to the Marriage Law specified property division in greater detail, reinstating the rural women's rights to land and housing upon divorce. It made unilateral divorce possible in cases of domestic violence and extra-marital relationships, which are grounds used mainly by women. Considering the more liberal legal climate for divorce, lessening of the stigma attached to divorce in the cities,

and more financial protection for women, this dissertation will test the following hypotheses:

Hypothesis 5: Enforcement of the 2001 Amendment to the Marriage Law leads to higher divorce risks.

1.3.1.3 Other control variables

Research evidence from 2000 to 2009 supports the idea that higher social economic status reduces the risk of divorce (cf., Karney & Bradbury, 2005). For example, higher levels of education (e.g., Heaton, 2002; Martin, 2006; Orbuch, Veroff, Hassan, & Horrocks, 2002) and greater income and financial resources (e.g., Orbuch, Veroff, Hassan, & Horrocks, 2002; Popenoe, 2007; South, 2001; Stanley, Amato, Johnson, & Markman, 2006) are associated with greater marital stability. Women are more able to control economic resources and have recently become economically independent. This may have increased their ability to seek or agree to a divorce if their marriages are unhappy (Honig & Hershatter, 1988). Zeng et al. (2002) emphasized that the province, residence type (rural or urban), women's education, occupation, age at marriage, whether the marriage was arranged, and parents' education are important sociodemographic characteristics affecting the chances of divorce.

1.3.2 The Health Model

1.3.2.1 Theories for marriage-health connection

Researchers have employed a variety of theories and conceptual perspectives to investigate how marriage influences individuals' well-being (Amato, 2000). Dominant explanations proposed for the health differences between marital status groups are social selection theory and social causation theory (Joung, van de Mheen, Stronks, van Poppel, & Mackenbach, 1998). The social causation theory encompasses two distinct yet not mutually exclusive explanations: the resource and stress models (also referred to as crisis model). The former argues that marriage has a health promoting or protective effect through economic and psychosocial resources (Ross, Mirowsky, & Goldsteen 1990; Waite & Gallagher, 2000). The latter holds that divorce would have adverse health effects because of the stress of marital dissolution (Gove, 1973; Kobrin & Hendershot, 1977; Verbrugge, 1979; Strohschein, McDonough, Monette, & Shao, 2005). A third theory, the Escape Theory, is the notion that a divorce can be a relief from marital problems. If problems in marriage have a negative effect on health, the ending of a problematic marriage implies some sort of relief (Wheaton, 1990: Williams, 2003).

Resource Model

Three primary aspects of the marital resource model include economic resources, social control, and psychosocial support (Carr & Springer, 2010). Many scholars find economic resource a key reason for better health among the married (Rogers, Hummer, & Nam, 2000). Gary Becker (1981) argues that marriage leads to specialization, economies of scale and the pooling of wealth. Economic resources may enhance health through

improving nutrition, providing care in the event of illness, allowing purchase of medical care and increasing access to health insurance (Ross, Mirowsky, & Goldsteen, 1990). Social control is important for the well-being and good functioning of an individual. Marriage provides a well-defined social role and spouses monitor and control each other's daily affairs and behavior (Gove & Hughes, 1980; Hughes & Gove, 1981). Thus, the married avoid risky behavior and conduct a healthier lifestyle (Gove, 1973; Hughes & Gove, 1981; Umberson, 1987; Verbrugge, 1979; Verbrugge & Madans, 1985). Social support is defined as "the commitment, caring, advice and aid provided in personal relationships." (Ross, Mirowsky, & Goldsteen, 1990) Social support from marriage may benefit mental health and mental health is positively correlated with physical health (Liu and Umberson 2008; Waite and Gallagher 2000).

Stress Model

Stress may affect physical health indirectly through undermining psychological well-being and promoting unhealthy behaviors (e.g., smoking, drinking) or directly through stimulating production of stress hormones (Kiecolt-Glaser and Newton 2001; Umberson 1987). Researchers continue to explore whether negative consequences of divorce should be conceptualized as a crisis or a chronic strain, which may affect health in distinct ways (Amato 2010).

The crisis model focuses on the notion that divorce is a stressful life event (Tschann, Johnston, & Wallerstein 1989) and negative effects of the dissolution process gradually decrease over time as people adjust to the new situation (Booth & Amato, 1991; Kitson & Morgan, 1990; Lillard, Brien, & Waite, 1995). However, it is less clear how quickly people

recover and how complete the adjustment is (Bloom, Niles, & Tatcher, 1985; Booth & Amato, 1991; Kitson, Babri, Roach, & Placidi, 1989; Wertlieb, Budman, Demby, & Randall, 1984). Longitudinal research by Hetherington (2003) reported that divorce was generally followed by short-term declines in psychological, social, and physical well-being among couples. Most individuals had adapted well to their new lives after a few years, although a significant minority remained seriously troubled.

The chronic strain model focuses on the notion that divorce involves persistent life strains including economic hardship, social isolation, and sole parenting responsibilities for single parents (Amato (2000). Chronic stress can have cumulative effects on physical health (Lovallo 2005) such as heart and respiratory ailments, diabetes, and hypertension (Freemont & Bird 2000; Wickrama, et al. 2001). Lorenz, Wickrama, Conger, & Elder Jr., (2006) found that while psychological distress increased following divorce and later declined among mothers, physical health problems were elevated 10 years later.

Escape Theory

Wheaton (1990) and Williams (2003) argued that the ending of a problematic marriage implied some relief if problems in marriage had negative effects on health. Kalmijn and Wonden (2006) called this research tradition the escape hypothesis. They made a distinction between a strong and a weak version of the hypothesis. The weak version argued that the divorce effect was less negative when the initial marital quality was low; the strong version argued that the divorce effect was positive when the initial quality was low. Hawkins and Booth (2005) argued that individuals who were in long-term low-quality marriages might benefit by dissolving their marriages, utilizing a nationally

representative longitudinal study over 12-year period in the United States. Wheaton (1990) analyzed Canadian panel data and found that people in marriages with many problems who divorced had lower symptoms of distress 2-4 years post-divorce.

1.3.2.2 Theory generality in the Chinese context

Understanding of these U.S.-based theoretical models sheds light on the links among internal migration, divorce and health in the general population in China, where research evidence is sparse.

Internal Migration

Although millions of married couples in China live apart and do not benefit fully from economies of scale such as sharing bills, earnings sent home by the migrant spouse could boost overall family income for these couples (Chen 2015). According to the National Bureau of Statistics of China (2006), 10% of migrant workers sent 30%-40% of their income to their families; 15.3% sent 40%-50% of their earnings; 11.2% sent 50%-60%; 23.5% sent 60%-70%; and 9.2% sent 70%-80% of their income home. From the economic resource perspective, we expect that married people whose spouses migrate may still enjoy the increased economic resources from pooling income, and thus better health, than the unmarried.

Some studies in the Chinese aging literature documented the health benefits of living with a spouse and the adverse effects of transition to widowhood for older adults (Korinek, Zimmer, & Gu, 2011; Li, Zhang, & Liang, 2009; Zeng, Vaupel, Xiao, Zhang, & Liu, 2002). In this sense, we expect that the "floating population" in China does not enjoy fully the

health benefit of marriage due to the loss of daily monitoring and controls of their healthy behavior from their spouses.

In the event of internal migration, physical separation may reduce couples' emotional closeness and reduce the levels of social support from the long-distance spouse in comparison with married couples who live together (Chen, Liu, Vikram, & Guo, 2015). On the other hand, some researchers argued that the benefits of marriage could come from its institutionalized nature (e.g., Waite and Gallagher, 2000) despite the physical separation. Married people whose spouse lives away from home may still have greater access to some psychosocial support as long as the "long-term contract" of marriage continues to be honored (Chen, 2015). Married people are generally presumed to have more socioemotional support than their unmarried peers. Nevertheless, recent studies found that this benefit is contingent on the emotional climate of one's relationship (Kiecolt- Glaser & Newton, 2001). Lou (2004) indicated that some women had supported their husbands' out-migration precisely because their relationships were already in trouble. Chen (2015) presumed those who are married in rural China make up a higher proportion of those who are in unhappy marriages but stay in the marriage because of strong cultural sanction against divorce. In addition to spousal support, Yi et al. (2007) pointed out that rural-urban migrants also lost other important networks of social capital when they moved to the cities. Social capital, including trust, reciprocity, and a sense of belonging, is associated with self-reported health. Thus, from the point view of social support, an ambiguous impact (or slightly negative impact) of internal migration on health was expected due to high heterogeneity among individuals' level of commitment and existing marital quality.

This dissertation proposes that, taken together, benefits associated with marriage may be less salient in the context of internal migration and "floating population" in China.

Hypothesis 6: Longer period people spent away from home negatively affects individuals' health.

Hypothesis 7: Longer period people spent away from home negatively affects their spouses' health

Divorce

Marriage quality is much studied in the West but with less understanding in the Chinese context. Fu (1988) and Chui (1994) posited that Chinese marriages were of high stability but low quality. Chen, Liu, Vikram, and Guo (2015) presumed those who were married in rural China made up a higher proportion of those who were in unhappy marriages but stay in the marriage due to strong social stigma toward divorce. In addition, despite the dramatic increase of divorce rates in China, its universal divorce rates are still comparatively lower than other developed counties. Divorce to marriage ratio was 22 for China, 53 for the United States, and 51 for Russia in 2011(United Nations Statistical Division, 2011). Therefore, it is likely that divorce occurred mainly in extenuating circumstances such as in abusive and tense marriages in China. Blood pressure levels are affected by domestic tension, and high marital quality is associated with lower ambulatory blood pressure (Holt-Lunstad, Birmingham, & Jones, 2008). It's plausible that couples in an unhappy marriage could experience elevated blood pressure levels that may be reduced by amicable separation so that escaping from a long-term marriage of poor quality and full of tension might imply some sort of relief (Wheaton, 1990; Williams, 2003). Therefore, it

is plausible that divorce may not significantly increase blood pressure levels and could even lower them for individuals in tense marriages.

Hypothesis 8: Divorce doesn't affect blood pressure levels significantly.

1.3.2.3 Other control variables

Migrants are found to have higher smoking prevalence post-migration compared with pre-migration. Migratory lifestyles were found to increase smoking initiation (Yang, Wu, & Rockett, 2009). Stress (Cui, Rockett, & Yang, 2012), poorer mental health, and time spent in the city (Mou, Fellmeth, & Griffiths, 2013) have been explored as risk factors for increased smoking. Migrants are reported to have elevated alcohol consumption (Lin, Li, & Yang, 2005). Previous studies have documented that there is a higher prevalence of hypertension in northern China compared with southern China, largely because of a greater body mass index (BMI), higher dietary salt intake, and other lifestyle factors that residents in the north (Reynolds, Gu, Muntner , Wu, & Chen, 2003). Smoking, excessive drinking, and sedentary lifestyles are other factors that increase risk for hypertension (Zhang, Guo, Zhang, Wu, & Wang, 2006; Malinski, Sesso, Lopez-Jimenez , & Buring, 2004; Beunza, Martınez-Gonzalez, Ebrahim, Bes-Rastrollo, & Nunez, 2007)

1.4 Scope and contributions

This dissertation draws data from the China Health and Nutrition Survey (CHNS), covering samples of about 7,200 households with over 30,000 individuals in nine provinces for nine survey waves spanning 22 years. It excludes the three mega cities that joined CHNS in 2011. This dissertation focuses on adults aged over 18 years old and ever married

during the period from 1989 to 2011. This dissertation only examines influencing factors on divorce risks and physical health for first marriages while I acknowledge the importance of remarriages on individuals' post-divorce adjustment and life-course well-being. Although marriage quality is recognized by some scholars as another key factor influencing divorce risks and individuals' health status, this research is not able to conduct further quantitative investigation on this subject due to the unavailability of such information in CHNS and thus is beyond the scope of this dissertation. I recognize that health is a multidimensional concept and it encompasses a large variety of measures. Cardiovascular disease is the number one cause of death in China and a major public health concern yet has received little attention in the literature. This dissertation focuses on physical health outcomes measured by blood pressure.

Overall, this dissertation compiled a complex and nationwide representative longitudinal dataset to investigate the inter-relationship among internal migration, marital dissolution and adult health. It encompassed particularly comprehensive and dynamic model specifications to examine factors that had been discussed extensively in the existing literature and factors that were unique in the Chinese context and/or had received little attention. Furthermore, since some effects of explanatory variables on outcomes are likely to be gradual, inter-relationships are dynamic in nature, and there is considerable heterogeneity in the circumstances facing individuals, econometric methods were carefully designed for drawing robust inference. It filled in a few major gaps in the literature on internal migration, marital dissolution, and marriage-health connection and commented on future data collection and analysis improvements. From the stand point of public policy, analytical results provided valuable information to Chinese policy makers on some of their

important and pressing policy initiatives such as migrant population management and services, one-child policy, sex ratio, hukou system reforms, and hypertension control.

The first set of models investigated the effects internal migration and variables such as son preference on the chances of marital dissolution. Sparse studies investigated factors driving divorce rates following Chinese economic reforms in late 1980s. For example, Wang & Zhou (2010) used 371 observations compiled from the China Statistical Yearbook to form a pooled time-series and cross-sectional data set to examine divorce and remarriage patterns at the provincial level. However, explanatory variables such as education and incomes were crudely approximated and the results were not very informative for policy makers. Xu, Yu, & Qiu (2015) used the first wave of the Chinese Family Panel Study in 2010 to investigate the relationship between children and divorce risk in the context of China. However, their cross-sectional model was not able to control for heterogeneity among couples, and they did not differentiate the potential differences in son preference among men and women. Zeng et al (2002) used data from the In-Depth-Fertility-Surveys in 1985 to study the association of divorce with socio-demographic covariates before 1985. This study covered only three provinces and had limited representation of the nationwide patterns of marriages.

This dissertation used more accurate measurements for internal migration such as the lengths of periods individuals were away rather than binary indicators, which are used in most studies on internal migration (Tong & Piotrowski, 2012; Chen, 2015). Secondly, gender composition of surviving children (Muhuri & Preston, 1991; Bhargava, 2003a) might have different effects on men's and women's chances of marital dissolution because of the one-child policy. In particular, men in an unhappy marriage with a first-born

daughter might be inclined to divorce and re-marry with the expectation of producing a son. Such asymmetries were partially addressed in previous research (Xu, Yu, & Qiu, 2015) and were systematically investigated in this dissertation. Previous studies have shown that characteristics of the CHNS households were comparable to those from national samples (see Du et al., 2002; Entwisle & Chen, 2002; Short et al., 2000). Estimation of probit models that control for unobserved heterogeneity via random effects (Vella & Verbeek, 1999) provided insights into the factors underlying marital dissolution in China.

By utilizing four waves of the CHNS data during 1997-2004, the second set of models examined factors influencing adult health, measured by blood pressure and self-reported health status. Evidence of the effects of marriage on physical health is rather speculative compared to the evidence of the effects of marriage on health risk behaviors, health insurance status, and psychological health (Wood, Goesling, & Avellar, 2007). Health measure is limited to a narrow range and does not provide a full picture of links between marriage and physical health. Some studies measured physical health using self-reported health status (Chen, Liu, Vikram, & Guo, 2015; Williams & Umberson, 2004). Self-reported health may be a poor proxy for changes in physical health, although it is correlated with objective physical health indicators such as blood pressure, disability, and longevity (Ferraro & Farmer, 1999). For example, people tend to rate their health in the same category even as their health declines with age. Trends in self-reported health may not reflect subtle changes in underlying physical health status (Wood, Goesling, & Avellar, 2007). Some studies addressed this limitation by focusing on alternative physical health indicators. For example, Prigerson, Maciejewski, and Rosenheck (2000) used longitudinal data from the ACL study to evaluate the association between marital transitions and chronic

health conditions such as arthritis, hypertension, and heart disease. Zhang and Hayward (2006) examined the effect of marriage on the risk of cardiovascular disease utilizing longitudinal data from the nationally representative Health and Retirement Survey in the United States. Wang (2005) investigated the effect of marital transitions on hypertension among Chinese women aged 20-59 in nine provinces.

High prevalence and poor control of hypertension is the leading cause of CVD and premature death in China and has become a major public health problem. Factors influencing hypertension risks are complex and include both socioeconomic and biological factors. For example, being divorced might have ambiguous effects on health indicators because couples in unhappy marriages could experience elevated blood pressure levels that may be *reduced* by amicable separation (cf. Waite and Gallagher, 2000). Moreover, while internal migration is an important explanatory variable for health status, it is plausible that individuals' migration durations are correlated with the errors affecting the models for their health status. In addition, China is experiencing increases in obesity due to the changes in dietary patterns and lifestyles (e.g. Whang et al., 2012). A high proportion of men smoke cigarettes and consume alcohol and these factors can increase blood pressure levels.

Earlier studies relied preliminarily on cross sectional data (Amato 2010). This dissertation represented some major advances over previous studies with longitudinal data from CHNS by tackling a few sets of methodological issues that had not been fully addressed by them. First, cross-sectional differences are not conclusive evidence that divorce is a major stressor (Mastekaasa, 1997). Such differences could be due to health selection for divorce (Kelly & Conley, 1987; Mastekaasa, 1992, 1994; Spanier & Furstenberg, 1982) or could be due to either a short-term impact or more permanent strains

associated with divorce (see Avison & Turner, 1988). By utilizing longitudinal data, this dissertation was able to control for initial health differences, if any, between those who remained married and those who did not. It was therefore able to disentangle social selection and causation effect. Second, previous levels of blood pressure were postulated to affect the current levels (Bhargava, 2003b) thereby enabling a distinction between short and long run effects of explanatory variables. Third, it is plausible that individuals' migration durations are correlated with the errors affecting the models for their health status. For example, individuals in poor health may not be able to work away from home for extended periods so that the errors affecting the model for blood pressure might be correlated with migration durations. Fourthly, couples' health status is likely to be influenced by the length of separation periods and can introduce feedback effects ("simultaneity") into the relationships. Previous research on China has not simultaneously addressed such issues. For example, while Tong and Piotrowski (2012) explained the chances of internal migration by self-reported health status using the CHNS data, Chen, Liu, Vikram, and Guo (2015) explained self-reported health by dichotomous variables for the spouse being away. In this dissertation, estimation of dynamic random effects models for self-reported health and blood pressure levels, accounting for the time dependence in variables and possible feedback effects, provided insights into the factors affecting marital dissolution and physical health in China.

Chapter 2: Internal migration, son preference and divorce in China: Divorce Models

China's divorce rates have increased dramatically since the late 1970s with its rapid economic growth and significant socio-demographic changes. This provides a compelling case for scholars to test the generality and external validity of existing theories and conceptual frameworks on marriage formation and dissolution that have been largely developed and studied based on the western population. More importantly, studying divorce phenomena in the Chinese context offers valuable information to public policies. First, analytical results inform whether divorce is a necessary result of societal and individual development and thus no restrictive policies are needed to curb the divorce rate per se, or divorce is a result of marginalization of a subpopulation and thus proactive policy initiatives are required to eliminate rooted social inequalities such as son preference. Second, investigation into the causal determinants of marital dissolution in China is a first step, and it sets the foundation to study divorce's impact on adults, children, and the society. It ultimately provides valuable information for policy makers to adopt effective policies to eliminate potential negative impacts.

In this chapter, comprehensive model specifications and advanced econometric methods were adopted to study the divorce phenomenon in China, based on nationwide representative longitudinal data. Research results filled in a big gap in the current literature and provided insights into relevant policies.

2.1Data and Measures

The China Health and Nutrition Survey (CHNS) is an international collaborative project between the Carolina Population Center at the University of North Carolina and the National Institute for Nutrition and Health at the Chinese Center for Disease Control and Prevention (CCDC) (Popkin, Du, Zhai, & Zhang, 2010). The longitudinal cohort in this dissertation consisted of 7,132 households with over 19,000 individuals who were observed in nine waves during 1989-2011. The data were collected on individual, household, and community levels, and covered nine provinces and autonomous regions in China: Liaoning, Heilongjian, Shandong, Jiangsu, Henan, Hubei, Hunan, Guangxi, and Guizhou (See Figure 3). One-third of the Chinese population lives in these provinces. A multistage and random cluster process was used to draw the sample surveyed in each of the provinces and the surveys took place over 7-day periods. Counties in the nine provinces were stratified by income (low, middle, and high) and a weighted sampling scheme was used to randomly select four counties in each province. Villages and townships within the counties and urban/suburban neighborhoods in the cities were randomly selected. The CHNS compiled demographic variables such as gender, ethnicity, age, household's location in rural and urban areas, and household size. Previous studies showed that characteristics of the CHNS households and individuals were comparable to those from national samples (Du et al. 2002; Entwisle & Chen, 2002; Short et al., 2000).

Figure 3: Nine Participating Provinces in CHNS 1989-2011[3]

Marital status of each adult was inquired for all survey waves. I used a few other survey questions to complementarily fill in missing values and to identify individuals' first marriages. These complementary variables were number of marriages, date of divorce, and spouse ID number. Only women under age 52 who were ever married and had given birth to child were asked the gender and date of birth of all their children. Based on this information, I calculated the number of sons for each survey wave for women and then filled in the information for their husbands through the Spouse ID linkages. Per capita household incomes were constructed and inflated to 2011 prices by the CHNS team for all survey rounds. Internal migration patterns were investigated for men and women by inquiring whether they had been away from home and the duration in months. There were changes in the questions from 1997 pertaining to months that individuals were away. Numbers of months away during the last few years were inquired for household members

[3] Source: http://www.cpc.unc.edu/projects/china/about/proj_desc/chinamap

and for those who had left the household. While previous studies used a dichotomous indicator to measure internal migration, this dissertation applied a more informative measurement of internal migration by the length. In addition, an index of internal migration was created based on the sum of binary responses to whether the individual had been away during the survey round. Education levels were recorded and a categorical variable was created that ranged from 0-6, with 0 reflecting less than 6 years' formal education at primary school and 6 reflecting a post-graduate degree. The Age variable was calculated based on the recorded date of birth for all respondents. I then calculated the age difference between spouses. Urban or rural site was recorded for all respondents for all survey waves. A binary indicator was used to indicate whether the 2001 Amendment to the Marriage Law had been implemented in that survey wave. Descriptive statistics are presented in Table 1.

Table 1: Sample means and standard deviations of variables for men and women during 1989-2011 in the CHNS [1]

Year:	1989	1991	1993	1997	2000	2004	2006	2009	2011
Households:									
Urban, 0-1	0.33	0.31	0.30	0.32	0.32	0.32	0.31	0.31	0.30
	(0.47)	(0.46)	(0.46)	(0.46)	(0.46)	(0.46)	(0.46)	(0.46)	(0.45)
Per Capita income	3072.80	3036.32	3455.80	4260.84	5544.95	7296.38	8254.73	11982.68	13480.29
	(2525.03)	(2217.67)	(2975.40)	(3601.55)	(5661.73)	(7630.83)	(11336.35)	(15804.90)	(15452.64)
ln(Per Capita	7.75	7.77	7.83	8.06	8.22	8.47	8.52	8.94	9.05
income)	(0.84)	(0.77)	(0.88)	(0.85)	(1.00)	(1.03)	(1.10)	(1.08)	(1.11)
Men:									
Age, years	40.01	41.16	41.64	42.79	44.05	46.90	47.52	49.85	51.23
	(14.99)	(15.18)	(15.06)	(15.16)	(14.86)	(14.69)	(14.37)	(14.00)	(13.75)
Education, 0-6	1.61	1.63	1.68	1.78	1.92	1.99	2.07	2.10	2.17
	(1.14)	(1.14)	(1.12)	(1.13)	(1.19)	(1.20)	(1.21)	(1.21)	(1.26)
Divorced, %	0.48	0.64	0.62	0.86	1.31	1.64	1.85	2.78	3.02
	(6.93)	(8.02)	(7.86)	(9.25)	(11.41)	(12.70)	(13.48)	(16.44)	(17.13)
Migration index,	0.10	0.19	0.28	0.25	0.30	0.38	0.50	0.56	0.66
0-9	(0.31)	(0.47)	(0.60)	(0.59)	(0.66)	(0.76)	(0.89)	(1.00)	(1.16)
Months away,	0.60	0.52	0.74	0.97	0.92	1.91	2.21	2.19	2.09
months	(2.18)	(1.97)	(2.52)	(9.61)	(5.55)	(9.57)	(14.08)	(12.63)	(13.05)
Women:									
Age, years	41.99	42.97	43.71	44.47	45.55	47.72	48.35	49.89	50.87
	(15.02)	(14.87)	(14.66)	(14.77)	(14.60)	(14.47)	(14.29)	(14.18)	(14.23)
Education, 0-6	1.12	1.13	1.17	1.30	1.46	1.51	1.61	1.66	1.74
	(1.13)	(1.13)	(1.13)	(1.16)	(1.23)	(1.24)	(1.26)	(1.27)	(1.33)
Divorced, %	1.49	1.73	1.90	2.51	2.59	3.02	3.07	3.74	4.43
	(12.14)	(13.05)	(13.66)	(15.66)	(15.91)	(17.11)	(17.27)	(18.99)	(20.59)
Migration index,	0.03	0.06	0.09	0.07	0.09	0.12	0.17	0.20	0.25
0-9	(0.17)	(0.26)	(0.31)	(0.28)	(0.31)	(0.38)	(0.48)	(0.56)	(0.66)
Months away,	0.17	0.18	0.23	0.25	0.43	1.13	0.98	1.19	1.29
months	(1.22)	(1.26)	(1.51)	(2.57)	(3.97)	(9.48)	(6.15)	(7.73)	(9.40)

[1] The data on 4784 men and 4592 women were available in 1989; for remaining years, available observations were used to compute sample means.

Table 1 reported the descriptive statistics for salient variables in the nine survey rounds of the CHNS, and results were presented separately for men and women for comparison. Approximately 32% of the households resided in urban areas. At the start of the surveys in 1989, the mean annual per capita household income adjusted to 2011 prices was 3,072 yuan. There was a steady increase in household incomes. The mean per capita household income in 2011 was 13,480 yuan, showing a 4-fold increase between 1989 and 2011. Nominal values of per capita household income from each survey wave were adjusted for inflation and were inflated to 2011 yuan currency values (CHNS, 2011). The data also showed an increasing income disparity among Chinese households, where the magnitudes of standard deviation of per capita household income increased from 1989 to 2011 and have become larger than the mean per capita household income since 2000.

Mean ages of men and women in households in 1989 were 40.01 and 41.99 years, respectively. The mean educational attainment for men in 1989 was 1.61 and it was significantly higher ($p<0.05$) than the mean 1.12 for women. Percentages of divorced men increased from 0.48 to 3.02 from 1989-2011, and corresponding figures for women were 1.49 and 4.43 percent, respectively. While there has been a dramatic increase of divorce rates in China, China's overall divorce rates are still comparatively lower than other developed counties. For instance, the crude divorce rate, which is the number of divorces per 1,000 population, was 2.0 for China and it was 3.6 and 4.8 for the United States and Russia in 2011, according to the United Nations Statistical Division. Divorce to marriage ratio, which is the number of divorces to the number of marriages in a given year, was 22 for China 53 and 51 for the United States and Russia in 2011 (United Nations Statistical

Division, 2011). It is likely that divorce occurred mainly in extenuating circumstances such as in abusive and tense marriages in China.

Means of the migration index based on binary responses in 1989 and 2011 for men were 0.10 and 0.66, respectively. Corresponding means for women were 0.03 and 0.25, respectively, showing that men had been away from home more frequently than women. Similarly, mean numbers of months for which men were away from home in 1989 and 2011 were 0.60 and 2.09, respectively. Corresponding means for women were 0.17 and 1.29, respectively, showing that men had been away from home for a longer period of time than women.

2.2 Empirical models and econometric methods

The first set of empirical models investigated causal determinants of marital dissolution using the CHNS data. To take advantage of nine waves of longitudinal data, this dissertation used random effect probit modeling techniques to estimate how migration and other explanatory variables might influence the probability of divorce for men and women. One of the major advantages of random effect probit modeling in comparison with simple probit modeling is its ability to distinguish the two levels (i.e., within- and between-individual) of heterogeneity in estimating probability of divorce shaped by migration level. With time-varying covariates, the models captured the time-dependence in relationships. The random effects probit model for ith individual's chance of divorce in period t was specified as follows:

$$\text{Divorce}_{(\text{pooled})it} = a_0 + a_1(\text{migration index})_{it} + a_2(\text{gender})_{it} + a_3(\text{urban})_{it}$$
$$+ a_4 \ln(\text{per capita household income})_{it} + a_5 \ln(\text{age})_{it} + a_6[\ln(\text{age})_{it}]^2$$
$$+ a_7 \ln(\text{age difference})_{it} + a_8(\text{education})_{it} + a_9(\text{number of sons})_{it} \quad (1)$$
$$+ a_{10}(\text{2001 Amendment to the Marriage Law})_{it} + u_{it} \quad (i=1,\ldots,N;\ t=1,\ldots,9)$$

where ln represented natural logarithms. Age difference was the difference between couples' ages. The migration index summed the binary responses for whether the individual was away in the nine waves for Specification 1. This variable was replaced by months away which recorded the time spent working away from home for Specification 2. Squared terms of age were included to take into account the nonlinear change of probability of marital dissolution with age. Note that eight indicator variables were also included in the model in equation (1) to account for differences in means of variables in the nice provinces; a set of nine indicator variables were included in the models to account for differences in means over time. In addition, coefficients of time the spouse spent away from home, employment, and numbers of girls were not significantly different from zero in preliminary analysis and such variables were dropped for enhancing the efficiency of parameter estimates.

The probit model in equation (1) for individuals' chances of divorce was estimated by maximum likelihood. Maximized values of the log-likelihood function were used to test for the constancy of model parameters for men and women. Further, the model in equation (1) was an "unbalanced panel" that different numbers of time observations were available for ith individual for estimation. The model was initially estimated by pooling the data for men and women and including an indicator variable for women. Likelihood ratio tests rejected the null hypothesis that the model parameters were constant across the two groups

and hence the results were reported separately for men and women in Table 2. Marginal effects of explanatory variables were reported in Table 3.

I noted that effects of independent variables were also likely to differ between urban and rural areas and a variable might have a stronger effect on one group than it did on the other. Likelihood ratio test also rejected the null hypothesis that the model parameters were constant across the two groups of urban and rural areas. Results were thus reported separately for urban and rural in Table 4. Marginal effects of explanatory variables were reported in Table 5. Random effects probit model for ith individual's chance of divorce in period t by region was not specified here for brevity.

The u_{it} were error terms that could be decomposed in a random effects fashion as:

$$u_{it} = \delta_i + v_{it} \quad (2)$$

where δ_i were individual specific effects that were assumed to be normally distributed with zero means and constant variance; v_{it}'s were normally distributed variables with zero means and constant variance.

Table 2: Random effects probit model for the probabilities of divorce for men and women using longitudinal data from nine waves in the period 1989-2011 from the CHNS [1]

	Men		Women	
Explanatory variables:	Specification 1	Specification 2	Specification 1	Specification 2
(Migration Index), n	0.003 (0.030)	-	0.307*** (0.097)	-
ln (Months away), months	-	0.083** (0.032)	-	0.075** (0.034)
Urban,0-1	0.074 (0.057)	0.221** (0.089)	0.560*** (0.132)	0.230** (0.096)
ln(Per capita Household Income), yuan	0.008 (0.026)	0.040 (0.044)	0.046 (0.047)	0.026 (0.047)
ln(Age), years	20.593*** (2.102)	15.745*** (2.850)	37.200*** (4.429)	10.336*** (3.452)
[ln (Age)]^2	-2.744*** (0.282)	-2.065*** (0.386)	-4.977*** (0.594)	-1.421*** (0.471)
ln(Age Difference), years	-0.141*** (0.037)	-0.263*** (0.061)	-0.996*** (0.127)	-0.325*** (0.076)
Education group, 0-6	-0.051** (0.024)	-0.124*** (0.041)	0.058 (0.051)	-0.037 (0.042)
Number of sons	-0.381*** (0.045)	-0.410*** (0.072)	-0.149* (0.086)	-0.112* (0.062)
2001 Amendment to Marriage Law, 0-1	2.037*** (0.063)	1.804*** (0.102)	4.473*** (0.287)	1.471*** (0.177)
Constant	-40.841 (3.879)	-32.479 (5.204)	-74.748 (8.331)	-21.456 (6.417
2 x Maximized log-likelihood function	-2425.40	-1027.58	-3048.18	-976.34
Chi-square (10) test parameter constancy[2]	148.48***	31.0***		
Rho[3]	0.000 (0.001)	0.000 (0.001)	0.810* (0.019)	0.025 (0.170)
Number of observations	41697	20372	41006	16504
Number of groups	8939	5715	9504	5280

[1] Values are maximum likelihood estimates of coefficients and their standard deviations
[2] Chi-square statistics for testing if the model parameters are the same for men and women.
[3] Rho is proportion of the variance contributed by random effects. * P<0.05.
* denotes significant at 10% level, ** denotes significant at 5% level and *** denotes significant at 1% level.

Table 3: Rrandom effects probit model for the probabilities of divorce for men and women using longitudinal data from nine waves in the period 1989-2011 from the CHNS: Marginal effects[1]

	Men		Women	
	Specification 1	Specification 2	Specification 1	Specification 2
Explanatory variables:	Margin	Margin	Margin	Margin
(Migration Index), n	0.00005	-	0.001***	-
ln (Months away), months	-	0.001**	-	0.001*
Urban,0-1	0.001	0.002**	0.002***	0.003**
ln(Per capita Household Income), yuan	0.0001	0.0004	0.0002	0.0003
ln(Age), years	0.297***	0.195***	0.175***	0.138**
$[\ln (Age)]^2$	-0.039***	-0.025***	-0.023***	-0.019**
ln(Age Difference), years	-0.002***	-0.003***	-0.004***	-0.004**
Education group, 0-6	-0.0007**	-0.001***	0.0002	-0.004
Number of sons	-0.005***	-0.005***	-0.0007	-0.001*
2001 Amendment to the Marriage Law, 0-1	0.029***	0.022***	0.021***	0.019***

[1] Marginal effects were computed at sample means.
* denotes significant at 10% level, ** denotes significant at 5% level and *** denotes significant at 1% level.

Table 4: Random effects probit models for the probabilities of divorce for urban and rural using longitudinal data from nine waves in the period 1989-2011 from the CHNS [1]

	Urban		Rural	
Explanatory variables:	Specification 1	Specification 2	Specification 1	Specification 2
(Migration Index), n	0.086 (0.078)	-	0.012 (0.027)	-
ln (Months away), months	-	0.059 (0.043)	-	0.068** (0.028)
Gender,0-1	0.189** (0.092)	0.0007 (0.094)	0.015 (0.046)	0.026 (0.073)
ln(Per capita Household Income), yuan	0.0007 (0.033)	0.021 (0.056)	0.013 (0.022)	0.036 (0.038)
ln(Age), years	19.419*** (6.454)	9.503*** (3.104)	16.832*** (1.786)	14.632*** (2.601)
[ln (Age)]^2	-2.640*** (0.866)	-1.301*** (0.423)	-2.263*** (0.241)	-1.936*** (0.354)
ln(Age Difference), years	-0.396*** (0.117)	-0.370*** (0.077)	-0.197*** (0.033)	-0.229*** (0.055)
Education group, 0-6	-0.025 (0.027)	-0.123*** (0.043)	-0.012 (0.022)	-0.028 (0.040)
Number of sons	-0.272*** (0.081)	-0.209*** (0.077)	-0.196*** (0.031)	-0.263*** (0.054)
2001 Amendment to the Marriage Law, 0-1	2.088*** (0.572)	1.284*** (0.135)	1.891*** (0.053)	1.785*** (0.086)
Constant	-37.964 (12.445)	-19.478 (5.642)	-33.687 (3.272)	-30.322 (4.720)
2 x Maximized log-likelihood function	-2290.29	-216.19	-3313.68	-1272.42
Chi-square (10) test parameter constancy[2]	18.08*	22.50***		
Rho[3]	0.176 (0.325)	0.000 (0.0001)	0.00001 (0.0002)	0.000 (0.00007)
Number of obs	26238	9902	56465	26974
Number of groups	6923	3362	11520	7633

[1] Values are maximum likelihood estimates of coefficients and their standard deviations
[2] Chi-square statistics for testing if the model parameters are the same for men and women.
[3] Rho is proportion of the variance contributed by random effects. * P<0.05.
* denotes significant at 10% level, ** denotes significant at 5% level and *** denotes significant at 1% level.

Table 5: Random effects probit models for the probabilities of divorce for urban and rural areas using longitudinal data from nine waves in the period 1989-2011 from the CHNS: Marginal Effect[1]

	Urban		Rural	
	Specification 1	Specification 2	Specification 1	Specification 2
Explanatory variables:	Margin[1]	Margin	Margin	Margin
(Migration Index), n	0.001	-	0.0001	-
ln (Months away), months	-	0.001	-	0.0007**
Gender,0-1	0.002**	0.00001	0.0002	0.0003
ln(Per capita Household Income), yuan	0.00001	0.0003	0.0001	0.0004
ln(Age), years	0.297***	0.170***	0.242***	0.169***
[ln (Age)]^2	-0.040**	-0.023***	-0.032***	-0.022***
ln(Age Difference), years	-0.006**	-0.006***	-0.002***	-0.002***
Education group, 0-6	-0.0003	-0.002***	-0.0001	-0.0003
Number of sons	-0.004**	-0.003***	-0.002***	-0.003***
2001 Amendment to the Marriage Law, 0-1	0.032**	0.023***	0.027***	0.020***

[1] Marginal effects were computed at sample means.

* denotes significant at 10% level, ** denotes significant at 5% level and *** denotes significant at 1% level.

2.3Results from random effects probit models for chances of divorce

Table 2 presents results from random effects probit models for men and women's chances of divorce using nine waves of the CHNS data. Initially, the data were pooled for men and women and the model parameters were estimated by maximum likelihood. However, likelihood ratio statistics for Specifications 1 and 2 in Table 2 were 148.48 and 31.0, respectively, rejecting the null hypotheses of parameter constancy for the two groups. Results were thus presented separately for men and women. Note that Specification 1 used migration index based on number of times individuals reported being away, whereas Specification 2 used the numbers of months that men and women were away from home. The marginal effects of the explanatory variables were estimated at the sample means and were reported in Table 3.

Main findings in Table 2 and Table 3 were, first, number of months that men and women were away from home increased the probabilities of divorce in Specification 2 (consist with Hypothesis 1). Marginal effects for men and women were approximately 0.001 and indicated small increases with migration durations. However, the migration index based on dichotomous responses was only significant in the model for women. This was perhaps not surprising since the number of months away conveyed more elaborate information (see Discussion). Second, probabilities of divorce for men and women in urban areas were significantly higher ($p<0.05$) than for their counterparts in rural areas. While the coefficients of per capita household incomes were estimated with positive signs in the models, they were not statistically different from zero.

Third, there were nonlinearities with respect to ages of men and women. Probability of divorce increased with individuals' ages though at a declining rate. Age could serve as

a proxy for marriage duration since there is much less disparity among Chinese for their ages at first marriage. This finding was consistent with other studies where divorce risk showed an inverted U-shaped curve in the duration of the marriage (Vignoli & Ferro, 2009; Lyngstad, 2004). Age, used as a proxy of marriage duration, was found to be the most influential element affecting individuals' divorce risks, considering the larger magnitude of its coefficients than those of other explanatory variables. This aligns with the argument that divorce is a last resort for an extremely unhappy marriage in Chinese society. It is very common for Chinese couples to wait until their children to grow up before they file for divorce, despite the very low quality of their marriage. This, again, is not surprising because of the deep rooted tradition that couples' relationships are inferior to the parent-child relationships (Lu & Lin, 1998). Moreover, age difference between couples significantly decreased the chances of divorce. Men with higher levels of education were significantly less likely to divorce whereas education's impact for women's divorce risks was not statistically significant.

Fourth, the pooled model (result not presented here) showed that individuals with more sons were less likely to divorce (consistent with Hypothesis 2). The number of sons was estimated with a negative and significant coefficient in the model for men indicating that men with sons were less likely to divorce. This was the case in both Specifications 1 and 2. This variable was not statistically significant in the models for women (supporting Hypothesis 3). In fact, a considerably higher proportion of men with only daughters who divorced went on to re-marry (see Discussion).

Fifth, the indicator variable for the 2001 Amendment to the Marriage Law was estimated with positive coefficients that were significant in all models (supporting

Hypothesis 4). By reducing the economic burden for divorced women, amendments to the laws increased the chances of divorce among unhappy couples.

Sixth, the proportion of residual variance explained by the random effects was estimated to be close to zero in the models for men indicating a "boundary solution;" this may have been partly due to serial correlation in the general errors (v_{it}'s in equation (2); see Discussion). However, the variance of the random effects was statistically significant in the model for women in Specification 1 indicating significant between-women differences. Finally, the estimated coefficients in specification 1 of Table 2 did not change noticeably when missing observations on explanatory variables were imputed (See below for details on Multiple Imputation).

Table 4 presented results from random effects probit models for divorce patterns in urban and rural areas. Likelihood ratio statistics for Specifications 1 and 2 in Table 4 were 18.08 and 22.50, respectively, rejecting the null hypotheses of parameter constancy for the two groups, indicating that at least one explanatory variable affected outcomes differently in urban and rural areas. The marginal effects of the explanatory variables were estimated at the sample means and were reported in Table 5.

The main findings in Table 4 and Table 5 were, first, the number of months that individuals were away from home increased the probability of divorce in rural areas, which was not surprising since the vast majority internal migrants moved from rural to urban areas. However, the migration index based on dichotomous responses was not significant in either urban or rural areas (See Discussion). Second, probabilities of divorce for urban women were significantly higher ($p<0.05$) than for those in rural areas and men (supporting

Hypothesis 5). Higher education level was associated with more stable marriages in urban areas and less stable marriages in rural areas. Third, some explanatory variables showed similar effects in urban and rural areas. Per capita household incomes were not statistically different from zero. Probability of divorce increased with individuals' ages though at a declining rate for both areas. Age differences between couples significantly decreased the chances of divorce. Son preference was salient in both areas. The 2001 Amendment to the Marriage Law was estimated with positive coefficients that were significant in all models.

2.4Discussion of the results from the Divorce Models

Chapter 2 presented comprehensive analyses of nine waves of longitudinal data from the China Health and Nutrition Surveys during 1989-2011, focusing on the effects of internal migration, son preference, and the 2001 Amendment to the Marriage Law on probabilities of marital dissolution.

Internal migration measurement and future studies

The number of months that men and women spent away from home significantly increased their respective chances of marital dissolution. This phenomenon was less evident when migration indices based on dichotomous responses were employed. From the perspective of future survey and study design, to better understand effects of internal migration on family dynamics in China, it would be useful to implement four strategies: first, compile data on the number of months that men and women spend away from home and hours of labor supply. Second, tailor study designs to improve response rates and decrease levels of attrition in order to minimize their impacts on study findings (Hosegood & Madhavan, 2012; Deeg 2002). For example, seasonal return migration during the

Christmas and Easter seasons was evident for men in South Africa (Collinson, Wolff, Tollman, & Kahn, 2006; Madhavan, Schatz, Clark, & Collinson, 2012). Similarly, the CHNS team tailored its study design and piloted new strategies in 2009 to have interviewers return to the communities during the Spring Festival to locate families and individuals they previously missed. An increase in follow-up rates was expected because many migrants would return to their home during the Spring Festival (Popkin, et al., 2010). A potential third strategy is to distinguish between mortality- and non-mortality-related attrition for a more accurate picture of attrition selection. Finally, compare empirical findings and theoretical frameworks among different countries (exemplified by Madhavan & Roy, 2012; Roy, 2008; Townsend, 2002), and to look for similarities that exist across contexts such as forms and patterns of floating population, methodological challenges for measurement, and labor migration's contribution to declines in marriage rates (Hosegood & Madhavan, 2012)

Internal migration and legislative reforms

This analysis sets the stage for addressing one key policy-driven question regarding the suboptimal and involuntary "split family" strategy and higher divorce rates among floating populations: how to remove barriers for floating populations to reunite with their spouses and families and to settle in urban areas. The level of internal migration will continue to increase and is expected to reach 291 million in 2020 from 253 million in 2014 (2015 Report on China's Migrant Population Development). The Census reported an increase of the average age of the floating population from 28.22 in 1982 to 30.8 in 2010. The national average age for first marriage increased from 25.3 in 2000 to 26.7 in 2010 for

men and from 23.4 in 2000 to 24.9 in 2010 for women. The latest Population Dynamics Monitoring Data showed that internal migrants who had lived in destination cities for longer than five years accounted for 37% of the total floating population in 2014. These numbers indicated that more internal migrants who were married might have to adopt an involuntary "split family" strategy for a longer period of time, which would in turn further increase the divorce rate.

Reforms on *hukou* system are not a stand-alone remedy to facilitate migrants' reunions with their spouses and families in urban areas. Comprehensive and in-depth reforms of other existing systems and policies such as education, employment, housing, medical care, social welfare, land, governmental budgeting and taxation, and operational administration are required. For instance, a proper cost sharing system among central government, local governments, corporations and individuals needs to be built in order to increase local government's capacity in providing basic public service covering all internal migration populations. Rural land management and land property systems need to be changed in order to protect rural-urban migrants' property rights and interests (2015 Report on China's Migrant Population Development).

Son preference, One-child Policy, and gender equality

Results in Table 2 and Table 3 showed that there was son preference among men while models for women did not reveal significant son-preference. Son-preference was evidenced in the patterns of re-marriages as well. Data show that 113 (29.1%) of the 388 men who divorced during 1989-2011 had re-married. Similarly, 191 (29.8%) of the 642 women who divorced had re-married. Differences between men and women were not statistically

significant. However, a closer look revealed that of the 113 men who had re-married, 66 had only daughters, *i.e.,* 58.4% of the divorced men with only daughters re-married. The corresponding figure for women was 44.5%, and differences were statistically significant (p=0.019). Son-preference, combined with the inability to have more children under the one-child policy and illegal sex-selective abortions, not only increased chances of marital dissolution but also created millions of missing girls in China. Son-preference deprived girls of equal opportunity for health care, nutrition, and education, which led to women's life-long wellbeing impairment. It also induced crimes such as women trafficking and ultimately accelerated aging problems in China.

Some scholars suggested that China might experience reductions in son preference as a result of China's rapid economic development, urbanization, raised education levels for women, and increased women's labor force participation (Chung & Das Gupta, 2007; Guilmoto, 2009). Das Gupta, Chung, and Li (2009) regarded the high level of circular migration as an effective channel for diffusing new social norms of gender equality from urban to rural areas. More importantly, they pointed out the important role of the government in promoting gender equity through effective public policies and legislation reforms (Das Gupta et al., 2009). For instance, it is still hard for Chinese women to demand their rightful inheritance regarding lineage assets such as land in the rural areas due to the strong customary rules that giving land to daughters is passing land out of the lineage (Chung & Das Gupta, 2007). Without a fundamental change in son-preference, the recent relaxation of the one-child policy in China may not bring down divorce rates or sex ratios as much as people would expect. This dissertation provided Chinese policy makers with valuable information about adopting more effective gender-equality campaign strategies:

son preference would be further reduced and a higher level of gender equality would be achieved if more interventions and media campaigns addressing these issues were targeted at men.

Cultural traditions and Marriage Law reforms

Empirical analyses in this chapter underscored the need for incorporating cultural factors and laws in China into the probit models for divorce. On one hand, age was found to be the most influential element affecting individuals' divorce risks due to the larger magnitude of its coefficients than that of other explanatory variables. This aligns with the argument that divorce is a last resort for an extremely unhappy marriage in Chinese society. It is very common for Chinese couples to wait until their children grow up before they divorce, despite the very low quality of their marriage. This course of conduct is a reflection of the old and deeply rooted Chinese cultural idea that couples' relationships are inferior to parent-child relationships (Lu & Lin, 1998). On the other hand, we see that the 2001 Amendment indicator variable was consistently estimated with positive and significant coefficients in all models. In this sense, divorce rates increased as a result of the legislation reform of the 2001 Amendment. An ultimate new social norm of putting the marriage relationship ahead of parent-child relationships, giving more value to and having higher expectations of marriage quality, and protecting equal property rights for women and men, will not be fostered through merely decreased stigma attached to divorce. It will be built and thrive through gradual and continuing legislation reforms.

2.5Attrition and missing values

Loss of sample members in subsequent rounds of survey is quite common in a longitudinal study. Attrition can result in a potential threat of bias by altering characteristics of the sample and threatening the external validity of the study (Miller & Wright, 1995). It may also bias longitudinal data by altering the covariance of variables if some groups in the longitudinal sample are underrepresented (Goudy, 1985; Norris, 1987). In this session, I provided descriptive statistics on how response rates, attrition, and missing values look like in the working dataset. t-test, baseline assessment, and multiple imputation were then used to comprehensively detect potential bias. A few remedies to decrease the level of attrition were discussed.

2.5.1 Response rates, attrition, and missingness in CHNS

Thomas (2001) concluded that the CHNS had probably been among the most successful large-scale surveys in developing countries in terms of keeping attrition low. Popkin, Du, Zhai, & Zhang (2010) claimed that response rates and attrition were very complex to determine, because CHNA had recruited new participants as replenishment samples if a community had less than 20 households since 1997. In addition, Liaoning Province didn't participate in the CHNS 1997 for natural disaster, political, and administrative reasons. A new province, Heilongjiang, was added in CNHS 1997. Both Liaoning and Heilongjiang provinces were surveyed in CHNS 2000 and all subsequent rounds. Popkin and colleagues gave a few reasons that caused majority loss to follow-up. The first was the missing people that they could not find due to these missing people's travel, hours of work or play, and/or refusal to come for anthropometric and clinical exams. The second was school children who were in boarding school and who entered colleagues.

The third was migrant work and the fourth reason was natural disasters and major redevelopment of housing in urban centers (Popkin, Du, Zhai, & Zhang, 2010).

The latest report of (Zhang, Zhai, Du, & Popkin, 2014) reported that attrition in the CHNS was assessed around 60% relative to the 1989 primary sample and80–88% relative to the previous round of survey. Unfortunately, no further detailed information was released from the CHNS team on exact attrition rate due to each of the above cause. In addition, Popkin, Du, Zhai, & Zhang (2010) did not spell out the difference between missing values and drop out, where the former referred to the loss of certain items of an questionnaire and the later referred to the loss of complete respondents and all their information in subsequent surveys (Deeg, 2002). Although attrition and missing values are not mutually exclusive and attrition is sometimes treated as a special case of missing values, such difference is important in the way that their bias detection and remedy strategies vary accordingly. I calculated and presented descriptive statistics on how overall response rate (Table 6, Table 7, Table 8), attrition (Table 9**Table 9** and Table 10), and missing values (Table 11) look like for the working data of this dissertation.

Table 6: CHNS response rates at the individual and household levels (working dataset)

	1989	1991	1993	1997	2000	2004	2006	2009	2011
Individual									
N	9376	9043	8736	9681	10725	10319	10783	10115	9699
Response rate(%)[1]	100	90.8	90.9	74.7	84.2	81.1	86.4	75.5	83.6
Response rate(%)[2]	100	90.8	84.1	63.3	63.9	53.6	54.7	46.3	41.5
Household									
N	3994	3802	3597	4018	4507	4369	4418	4342	4215
Response rate(%)[1]	100.0	94.0	93.4	78.4	88.6	84.6	88.9	82.5	87.7
Response rate(%)[2]	100.0	94.0	89.3	70.6	75.0	65.7	66.0	60.0	55.7

[1] Based on previous year.
[2] Based on 1989 samples.

Table 7: CHNS survey participation rate for 1989 cohort households and individuals (working dataset)

Rounds participated	Household		Individual	
	Percentage	Cumulative percentage	Percentage	Cumulative percentage
All nine rounds	40.71	40.71	29.87	29.87
Eight rounds	13.40	54.11	11.17	41.04
Seven rounds	8.76	62.87	8.68	49.72
Six rounds	6.5	69.38	7.05	56.77
Five rounds	7.19	76.56	8.30	65.07
Four rounds	6.31	82.87	9.43	74.50
Three rounds	9.74	92.61	12.84	87.34
Two rounds	4.63	97.25	6.54	93.88
One rounds	2.75	100.00	6.12	100.00

Table 8: CHNS survey participation rate for 1989-2011 households and individuals (working dataset)

Rounds participated	Household		Individual	
	Percentage	Cumulative percentage	Percentage	Cumulative percentage
All nine rounds	22.80	22.80	14.42	14.42
Eight rounds	7.68	30.48	5.94	20.36
Seven rounds	5.33	35.81	5.06	25.41
Six rounds	11.15	46.96	10.33	35.74
Five rounds	8.85	55.80	9.62	45.36
Four rounds	10.33	66.14	12.26	57.62
Three rounds	10.43	76.57	13.43	71.05
Two rounds	12.11	88.68	14.44	85.49
One rounds	11.32	100.00	14.51	100.00

Table 6 showed that 9376 individuals were interviewed in the first round of survey in 1989 in eight provinces in China. Response rate based on 1989 cohort dropped to 63.3% in 1997 mostly due to the non-participation of Liaoning Province. Note that response rates did not necessarily equal to dropout rates. Rather, it reflected missing values of the 1989 cohort respondent for that particular survey round only, meaning these missing respondents might join the survey again in the later waves. Overall response rate for 1989 cohort households ranged from 55% to 94% from 1991 to 2011. When response rates were calculated based on previous years, meaning after including replenished samples, individual response rates ranged from 75.5% to 90.9% and household response rates ranged from 78.4% to 94%. Table 7 showed that over 76% of 1989 cohort households participated in five to nine surveys and an additional 16% in three to four surveys. About two-third of 1989 cohort individuals participated in five to nine surveys. Taking replenishment samples into account, Table 8 showed that 56% of households participated in five surveys and more. Around 71% of individuals participated in at least three surveys, spanning over 8-10 years.

Table 9: CHNS dropout rates at the individual levels (working dataset)

	1991	1993	1997	2000	2004	2006	2009	2011
Individual								
N[1]	571	512	1111	596	704	431	905	650
Dropout rate (%)[1]	6.09	5.45	11.84	6.35	7.50	4.59	9.64	6.93
N[2]	571	554	1198	1118	1332	1011	2286	1654
Dropout rate (%)[3]	6.09	6.12	13.71	11.54	12.41	9.79	21.20	16.35

[1] Based on 1989 samples.
[2] Based on 1989 and replenishment samples.
[3] Based on previous year (including replenishment samples).

Table 10: Number and percent of 1989 participants who died between the prior survey and 2011 (working dataset)

	1991	1993	1997	2000	2004	2006	2009	2011
N	42	54	60	48	50	16	46	18
%	0.448	0.5761	0.6401	0.5121	0.5334	0.1707	0.4907	0.192

Table 9 and Table 10 presented statistics for dropout rate at individual levels, meaning the loss to follow-up of complete respondents and all their information in subsequent survey rounds. Due to the lack of detailed information and potential overlap reasonings, I was not able to calculate exact dropout rates for each specific reason Popkin, Du, Zhai, & Zhang (2010) gave. An exception was the attrition due to death because the date of death was inquired in the survey questionnaires. Aattrition due to aging and mortality is inevitable. (Deeg, 2002). This is not a problem in a sense that mortality is a natural phase that occurs in both survey samples and in the population (Norris & Goudy, 1986). I abstracted information on date of death in the household survey and reported a total of 334 respondents (3.6%) from 1989 cohort died from 1991 to 2011, as shown in Table 10. According to the National Bureau of Statistics of China, China's annual crude death rate (per 1000) is 6.54, 6.45 and 7.14 in the year of 1989, 2000 and 2011, respectively (National Bureau of Statistics of China, 2011). I did not see attrition due to death a great problem. In terms of attrition due to internal migration, 4168 people had ever reported internal migration experience during 1989-2011, among whom 2366 were found having at least one physical health measurement recorded in subsequent survey rounds. This indicated that 57% of internal migrants returned home at some point and CHNS was able to follow up with them.

Table 11: Missingness of variables in models for the probability of divorce for men and women from 9 waves in the period 1989-2011 from the CHNS

Variables	N	Percentage
(Migration Index), n	851	0.96%
Ln(months away), months	48755	55.10%
Urban,0-1	0	0.00%
ln(Per capita Household Income), yuan	3888	4.39%
ln(Age), years	3	0.00%
$[\ln (Age)]^2$	3	0.00%
ln(Age Difference), years	57	0.06%
Education group, 0-6	1890	2.14%
Number of sons	3	0.00%
2001 Amendment, 0-1	3	0.00%

Table 11 listed the missingness of explanatory variables in divorce models for men and women. Missing observations for age, number of sons, and the 2001 Amendment to the Marriage Law were insignificant and were expected to have minimal impact on overall estimation results. Missing observations for migration, education, per capita household income, and age difference might bias model estimations. Potential bias was investigated by multiple imputation techniques in the next session.

2.5.2 Testing for bias: attrition

One of the most common methods for detecting potential attrition bias is to use t tests to compare those subjects who responded to all waves of the study (the Stayers) with those who dropped out (the Drop-outs) (Miller & Wright, 1995). The means of variables are compared between the two samples to determine if the differences are statistically significant. As shown in Table 12, attrition appeared to be selective in the sense that there were significant differences in the means of variables between the stayers and the drop-outs in the working dataset. However, what is of concern is not the level of attrition or

mean differences. Rather, the concern is whether, or to what extent, it invalidates the inferences (Behrman, 2010).

Theoretically, the generalizability of a longitudinal study may not be as great a problem in contrast with a cross-sectional study (Deeg, 2002), because longitudinal data controls for unobserved individual fixed effects such as innate ability and health, explores dynamic effects over time, and examines impacts of changing contextual factors (Behrman, 2010). Nevertheless, given the importance of attrition in potentially biasing estimation results and inference, I tested whether coefficients in Table 2, Table 3, Table 4, and Table 5 differ significantly from estimated parameters using the CHNS 1989 cohort data (Behrman, 2010). Baseline estimation results were presented in Table 13, Table 14, Table 15, and Table 16for divorce models.

No significant differences were found between the central estimation results and estimation based on CHNS 1989 cohort even if mean characteristics do differ significantly. Comparing estimation results in Table 2 and Table 13, women's migration experience was no longer statistically significant. Age difference and education level were no longer significant for men's specification 1. Other than these, all the rest estimation results had similar magnitudes and remained statistically significant. Estimation results for urban and rural areas showed a similar picture (Table 4 and Table 15). While gender and education were no longer statistically significant in urban areas for specification 1, all the rest estimation results had very similar magnitudes and remained statistically significant. This finding is consistent with many other studies for developing countries that most key results are not influenced by sample attrition (Behrman, 2010; Hoddinott, Maluccio, Behrman, Flores, & Martorell, 2008). Taken together, despite the fact that attrition was nonrandom

and respondents who dropped out had different mean values on variables, no serious bias was evidenced after comparing estimation results of complete working dataset and CHNS 1989 cohort baseline. Therefore, I concluded that attrition did not appear to be as great a problem as common belief holds (Deeg, 2002).

Table 12: t-test for detecting attrition bias (working dataset)

	Stayer	Drop-outs
Divorced indicator, 0-1	0.0007 (0.0001)	0.011 (0.0007)***
Self-reported health	2.355 (0.006)	2.463 (0.009)***
Systolic BP	119.741 (0.116)	121.946 (0.165)***
Diastolic BP	76.662 (0.070)	77.020 (0.091)***
(Migration Index), n	0.275 (0.003)	0.192 (0.003)***
ln (Months away), months	0.682 (0.008)	0.334 (0.006)***
Urban,0-1	0.190 (0.002)	0.410 (0.003)***
Gender	0.484 (0.002)	0.480 (0.003)
ln(Per capita Household Income), yuan	8.177 (0.006)	8.046 (0.006)***
ln(Age), years	3.815 (0.001)	3.837 (0.002)***
$[\ln (Age)]^2$	14.642 (0.011)	14.856 (0.017)***
ln(Age Difference), years	0.662 (0.003)	0.678 (0.005)***
Education group, 0-6	1.451 (0.005)	1.384 (0.008)***
Number of sons	1.106 (0.004)	0.582 (0.005)***
2001 Amendment to the Marriage Law, 0-1	0.006 (0.0004)	0.035 (0.001)***
Number of cigarettes smoked per day	7.480 (0.056)	6.184 (0.060)***
ln (Alcohol consumption index), n	12.735 (0.192)	11.797 (0.258)***
ln (BMI), kg/m^2	22.509 (0.019)	22.391 (0.025)***

* denotes significant at 10% level, ** denotes significant at 5% level and *** denotes significant at 1% level.

Table 13: Random effects probit models for the probabilities of divorce for men and women using longitudinal data from nine waves in the period 1989-2011 from the CHNS [1]: 1989 Cohort

	Men		Women	
Explanatory variables:	Specification 1	Specification 2	Specification 1	Specification 2
(Migration Index), n	0.015 (0.040)	-	0.102 (0.153)	-
ln (Months away), months	-	0.110*** (0.039)	-	0.110 (0.124)
Urban,0-1	0.120 (0.073)	0.218** (0.104)	0.522*** (0.154)	0.722*** (0.243)
ln(Per capita Household Income), yuan	0.010 (0.035)	-0.010 (0.051)	-0.018 (0.058)	-0.074 (0.108)
ln(Age), years	17.989*** (2.809)	13.663*** (3.413)	16.481*** (5.199)	18.708** (8.222)
[ln (Age)]^2	-2.395*** (0.374)	-1.810*** (0.459)	-2.181*** (0.685)	-2.550** (1.110)
ln(Age Difference), years	-0.067 (0.046)	-0.231*** (0.070)	-0.377*** (0.113)	-0.966*** (0.271)
Education group, 0-6	-0.045 (0.031)	-0.108** (0.046)	0.088 (0.067)	-0.075 (0.106)
Number of sons	-0.359*** (0.053)	-0.452*** (0.084)	-0.023 (0.084)	-0.116 (0.147)
2001 Amendment to the Marriage Law, 0-1	1.716*** (0.089)	1.418*** (0.135)	2.325*** (0.373)	1.393*** (0.508)
Constant	-36.070 (5.223)	-27.873 (6.278)	-35.258 (10.063)	-38.204 (15.350)
2 x Maximized log-likelihood function	-1435.89	-756.42	-1244.21	-581.16
Chi-square (10) test parameter constancy[2]	61.83***	45.51***		
Rho[3]	0.000 (0.00003)	0.000 (0.00004)	0.640*** (0.083)	0.721*** (0.083)
Number of obs	27288	15858	25815	13610
Number of groups	4635	4514	4396	4335

[1] Values are maximum likelihood estimates of coefficients and their standard errors from "unbalanced panels."
[2] Chi-square statistics for testing if the model parameters are the same for men and women.
[3] Rho is proportion of the variance contributed by random effects. * P<0.05.
* denotes significant at 10% level, ** denotes significant at 5% level and *** denotes significant at 1% level.

Table 14: Random effects probit models for the probabilities of divorce for men and women using longitudinal data from nine waves in the period 1989-2011 from the CHNS: 1989 Cohort Marginal Effect[1]

	Men		Women	
	Specification 1	Specification 2	Specification 1	Specification 2
Explanatory variables:	Margin[1]	Margin	Margin	Margin
(Migration Index), n	0.0001	-	0.0001	-
ln (Months away), months	-	0.001***	-	0.000003
Urban,0-1	0.001	0.002**	0.0005	0.00002
ln(Per capita Household Income), yuan	0.0001	-0.0001	-0.00002	0.000002
ln(Age), years	0.228***	0.155***	0.018	0.0006
[ln (Age)]^2	-0.030***	-0.020***	-0.002	-0.00009
ln(Age Difference), years	-0.0008	-0.002***	-0.0004	-0.00003
Education group, 0-6	-0.0005	-0.001**	0.00009	-0.000002
Number of sons	-0.004***	-0.005***	-0.00002	-0.000004
2001 Amendment to the Marriage Law, 0-1	0.021***	0.016***	0.002	0.00005

[1] Marginal effects were computed at sample means.

* denotes significant at 10% level, ** denotes significant at 5% level and *** denotes significant at 1% level.

Table 15: Random effects probit models for the probabilities of divorce for urban and rural using longitudinal data from nine waves in the period 1989-2011 from the CHNS[1]: 1989 Cohort

	Urban		Rural	
Explanatory variables:	Specification 1	Specification 2	Specification 1	Specification 2
(Migration Index), n	0.049 (0.077)	-	0.022 (0.042)	-
ln (Months away), months	-	0.035 (0.075)	-	0.073* (0.037)
Gender,0-1	-0.008 (0.077)	-0.018 (0.108)	-0.125* (0.070)	-0.108 (0.096)
ln(Per capita Household Income), yuan	-0.009 (0.043)	0.0009 (0.071)	-0.008 (0.032)	-0.040 (0.046)
ln(Age), years	10.659*** (2.995)	8.745** (3.789)	15.982*** (3.015)	14.125*** (3.554)
[ln (Age)]^2	-1.462*** (0.402)	-1.206** (0.513)	-2.117*** (0.399)	-1.877*** (0.478)
ln(Age Difference), years	-0.204*** (0.056)	-0.406*** (0.093)	-0.082* (0.046)	-0.263*** (0.072)
Education group, 0-6	-0.031 (0.032)	-0.124** (0.050)	-0.002 (0.035)	-0.042 (0.050)
Number of sons	-0.185*** (0.058)	-0.211** (0.087)	-0.192*** (0.047)	-0.259*** (0.065)
2001 Amendment to the Marriage Law, 0-1	1.342*** (0.111)	0.587** (0.250)	1.728*** (0.126)	1.448*** (0.130)
Constant	-21.470 (5.533)	-17.762 (6.940)	-32.580 (5.681)	-28.561 (6.550)
2 x Maximized log-likelihood function	-1085.80	-552.13	-1639.02	-811.35
Chi-square (10) test parameter constancy[2]	17.12	19.61***		
Rho[3]	0.000 (0.00002)	0.00002 (0.0008)	0.070 (0.079)	0.006 (0.059)
Number of obs	14842	8482	38261	20986
Number of groups	2964	2900	6067	5949

[1] Values are maximum likelihood estimates of coefficients and their standard errors from "unbalanced panels."
[2] Chi-square statistics to test if model parameters are the same for men and women.
[3] Rho is proportion of the variance contributed by random effects. * P<0.05
* denotes significant at 10% level, ** denotes significant at 5% level and *** denotes significant at 1% level.

Table 16: Random effects probit models for the probabilities of divorce for urban and rural using longitudinal data from nine waves in the period 1989-2011 from the CHN: 1989 Cohort Marginal Effect[1]

	Urban		Rural	
	Specification 1	Specification 2	Specification 1	Specification 2
Explanatory variables:	Margin	Margin	Margin	Margin
(Migration Index), n	0.0008	-	0.0001	-
ln (Months away), months	-	0.0005	-	0.0006*
Gender,0-1	-0.0001	-0.0002	-0.001*	-0.0009
ln(Per capita Household Income), yuan	-0.0001	0.00001	-0.00006	-0.0003
ln(Age), years	0.186***	0.133**	0.132***	0.125***
$[\ln (Age)]^2$	-0.025***	-0.018**	-0.017***	-0.016***
ln(Age Difference), years	-0.003***	-0.006***	-0.0006*	-0.002***
Education group, 0-6	-0.0005	-0.001**	-0.00001	-0.0003
Number of sons	-0.003***	-0.003**	-0.001***	-0.002***
2001 Amendment to the Marriage Law, 0-1	0.023***	0.008**	0.014***	0.012***

[1] Marginal effects were computed at sample means.
* denotes significant at 10% level, ** denotes significant at 5% level and *** denotes significant at 1% level.

2.5.3 Testing for bias: missing values

Multiple imputations (Rubin, 1987) were used to assess the effects of missing observations on the estimated parameters of the divorce model. Table 11 reported the missingness of variables in the divorce model. Missing observations for age, number of sons, and the 2001 Amendment to the Marriage Law were not computed to increase imputation efficiency, considering their minimal impact on overall estimation. Missing observations for migration index, education, per capita household income, and age difference were predicted by "predictive mean matching (PMM)." Missing values of these four variables were imputed for four survey waves from 1997 to 2006. The choice of the model and subsample were reasonable since numerical optimization schemes necessary for estimating binary models and longitudinal data required much more intensive computational efforts, in contrast with cross-sessional data. Length of migration was not computed due to its over 50% missing values, which is not suitable for multiple imputation.

Table 17 reported results for marital dissolution by pooling the results from 5 and10 imputations. Results from 5 and 10 sets of imputation were extremely close for men and women, respectively. Overall, results based on imputed datasets were similar to those reported in the Specification 1 of Table 2, which dropped missing observations during the estimation process. For example, except the migration index variable, coefficients that were statistically significant in Specification 1 of Table 2 for women had similar magnitudes and remained statistically significant in results from multiple imputations in Table 17. While age difference and education were no longer significant in the multiple imputation results for men, other explanatory variables remained statistically significant. Note that migration index was a suboptimal option for measuring internal migration and it

provided less accurate information than measuring the length of migration by month (see Discussion). Nevertheless, as a whole, results from multiple imputations were generally consistent with those from Table 2, indicating that missing observations induced limited bias on estimated parameters of the divorce model.

Table 17: Estimated parameters from multiple imputation probit models for the probabilities of divorce for men and women using longitudinal data from four waves in the period 1997-2006 from the CHNS [1]

Explanatory variables:	Men		Women	
(Migration Index), n	-0.245 (0.126)	-0.245 (0.126)	-0.175 (0.213)	-0.174 (0.213)
Urban,0-1	-0.059 (0.195)	-0.058 (0.195)	0.672 (0.165)***	0.671 (0.165)***
ln(Per capita Household Income), yuan	-0.144 (0.087)	-0.146 (0.087)	-0.035 (0.081)	-0.034 (0.081)
ln(Age), years	67.629 (9.461)***	67.606 (9.458)***	47.557 (7.815)***	47.541 (7.814)***
$[\ln (Age)]^2$	-9.105 (1.280)***	-9.102 (1.279)***	-6.603 (1.067)***	-6.600 (1.067)***
ln(Age Difference), years	-0.172 (0.120)	-0.173 (0.120)	-1.069 (0.154)***	-1.069 (0.154)***
Education group, 0-6	0.035 (0.080)	0.034 (0.080)	0.051 (0.071)	0.052 (0.071)
Number of sons	-0.914 (0.158)***	-0.915 (0.158)***	-0.202 (0.118)*	-0.202 (0.118)*
2001 Amendment to the Marriage Law, 0-1	3.650 (0.186)***	3.651 (0.186)***	2.522 (0.177)***	2.521 (0.177)***
Constant	-128.528 (17.412)	-128.467 (17.408)	-89.452 (14.248)	-89.435 (14.246)
Number of imputations	5	10	5	10

[1]Model estimated by logit regression 5 and 10 times using complete samples with imputations and the reported estimates were pooled. There were 21,099 men and 19,573 men with complete data. There are 20,409 women and 18,975 women with complete data.

* denotes significant at 10% level, ** denotes significant at 5% level and *** denotes significant at 1% level.

Chapter 3: Internal migration, divorce and health in China: Health Models

Inter-relationships among internal migration, divorce, and health are dynamic and complicated in nature. For example, while the extent to which migrants can work under difficult conditions might depend on their health status (e.g. Mou et al., 2013), migrants' health status is likely to be influenced by the length of migration periods and can introduce feedback effects ("simultaneity") into the relationships. While divorce might have a negative impact on individual health, unhealthy individuals are also more likely to divorce (Sbarra & Nietert, 2009). Some effects of explanatory variables on various outcomes are likely to be gradual and thus it requires modelling with a long-term frame. Finally, there is considerable heterogeneity in the circumstances facing couples. Therefore, longitudinal data is required to study these dynamic inter-relationships and comprehensive model specifications, and advanced econometric methods are essential for drawing robust inference. As far as I am aware, there has been no study so far to solve the above problems simultaneously. In this chapter, dynamic random effects models for self-reported health status and systolic and diastolic blood pressures were estimated by maximum likelihood methods, based on a nationwide representative longitudinal data from CHNS between 1997 and 2006.

From the subpopulation health perspective, rural-urban migrants are at a higher health risk than their urban and rural counterparts due to unfavorable working and living conditions, low awareness of disease prevention and lower immunization status (Fu, Xu, & Liu, 2010; Mou, Griffiths , & Fong, 2010; Abdulraheem, 2007). On one hand, migratory experience was found to be associated with lower measures of self-reported health (Chen,

Liu, Vikram, & Guo, 2015). However, self-reported health is a poor proxy for changes in physical health. For example, trends in self-reported health may not reflect subtle changes in underlying physical health status (Wood, Goesling, & Avellar, 2007). More importantly, people across different income groups and education levels have different expectations about and understanding of what a "good' health status should be (Graham, Zhou, & Zhang, 2015). The "progress paradox" is evident in transitioning China in that poor and rural respondents are likely to report better health status (He & Wong, 2011; Knight & Gunatilaka, 2010a; Graham, Zhou, & Zhang, 2015; Knight & Gunatilaka, 2011). On the other hand, the complex mechanisms and impacts of rural–urban migration on non-communicable chronic diseases (NCDs) are less documented. Migratory experience and lifestyles increase risks of a higher age-related rise in blood pressure, smoking initiation, and alcohol consumption (He , Klag, & Whelton, 1991; Yang, Wu, & Rockett, 2009; Lin, Li, & Yang, 2005). Migration experience might affect NCDs in a more subtle way as well. Family disruption, such as spousal separation and marital dissolution, due to internal migration has deleterious effects on migrants' physical health (Hu et al., 2008; Lu, 2010). In addition, healthier people might be more likely to migrate but their health status might deteriorate due to limited healthcare access and unfavorable working and living conditions in urban areas.

In the context of marriage-health connection, it is important to augment the analyses of self-reported measures with blood pressure levels. Using blood pressure as the health outcome is vital in the Chinese context where divorce rates are climbing; hypertension prevalence is increasing dramatically and has a long term and deadly mortality impact. In addition to marital status, marriage quality is another important factor explaining the

connection between marriage and well-being (Anson, 1989; Glenn, 1975; Gove, 1972). Fu (1988) and Chui (1994) posited that Chinese marriages were of high stability but low quality. Chen, Liu, Vikram, and Guo (2015) presumed those who were married in rural China made up a higher proportion of those who were in unhappy marriages but stayed in the marriage due to strong social stigma toward divorce. Considering China's overall divorce rate is low when compared to other developed countries, divorce is most likely the last resort for couples in extremely bad relationships and low-quality marriages in China. Blood pressure levels are affected by and can reflect domestic tension. Couples in unhappy marriages could experience elevated blood pressure levels that may be *reduced* by amicable separation so that being divorced might have ambiguous effects for health indicators (e.g. Waite and Gallagher, 2000).

Estimation results based on rigorous analysis are of great importance from both the literature and public policy perspectives. This study extended the application of divorce-health theories to the Chinese context and investigated the generality of divorce-health theories that were mostly built using data from western countries. It further explored the issue of heterogeneity within the married group, where spousal separation was a common living arrangement for millions of Chinese families but was rare in the western countries, and contributed to the marriage-health literature. It made an explicit causal inference between internal migration and chronic disease risks in China that had been mostly missing and neglected, whereas scholars in chronic disease prevention research in China had focused on ageing and its effects on disease prevalence. It also set foundations and made possible future comparison with other countries with similar high levels of internal migration such as South Africa to develop more effective study design and survey

strategies. In terms of public policy, the estimation results: 1) shed light on policies to integrate migrants into urban social welfare schemes and policy reforms to address health needs of rural-urban migrants; 2) shed light on the neutral impacts of divorce on adults' physical health in the Chinese context and called for future studies on its impact on children; 3) informed public health initiatives to decrease blood pressure at the population level to reduce medical debt burden to individuals, families, and society; and finally 4) urged developers of public policy to apply a social inclusion lens with particular attention paid to the marginalized and socioeconomically disadvantaged subpopulation such as the divorced, rural-urban migrants, and women, for shared prosperity, equality and wellbeing improvements for all.

3.1Data and measures

The self-reported health of individuals was inquired in four waves between 1997 and 2006 using a scale of 1-4 that was transformed so that 1 and 4 indicated, respectively, poor and excellent health status. Moreover, individuals' systolic and diastolic blood pressures were measured in all survey rounds using a spirometer. Heights of individuals were measured using Shorr boards; weight was measured in all survey rounds using electronic scales that were calibrated. I then calculated BMI by dividing weight (in kilograms) by squared height (in meters). Survey questionnaires also inquired if individuals were smokers and recorded the number of cigarettes smoked daily. Alcohol consumption was inquired, and an index was constructed by summing the amount of beer, wine, and liquor consumed per week. In addition, numbers of months away were averaged to create variables that

reflected migration durations for 1997-2011. The two variables assessing internal migration levels were utilized in the empirical analyses.

Table 18 reports descriptive statistics. The mean levels of self-reported health for men in 1997, 2000, 2004 and 2006 were 2.14, 2.20, 2.27, and 2.30, respectively. Corresponding figures were slightly higher for women and the differences were statistically significant ($p<0.05$). Means of systolic and diastolic blood pressures were significantly higher for men in all survey rounds. By contrast, means of BMI were similar for men and women and the differences were generally not significant. However, there were significant differences in smoking and alcohol consumption patterns of men and women. For example, mean numbers of cigarettes smoked by men in 1997, 2000, 2004 and 2006 were, 12.12, 11.90, 11.51, and 11.35, respectively. Corresponding figures for women were 0.88, 0.85, 0.75, and 0.74, respectively. The index of alcohol consumption was significantly higher for men in all survey rounds.

Table 18: Sample means and standard deviations of variables for men and women during 1997-2006 in the CHNS [1]

Year:	1997 Mean	2000 Mean	2004 Mean	2006 Mean
Men:				
Systolic BP, mm Hg	122.0	122.6	124.9	124.5
	(16.6)	(16.4)	(17.3)	(16.7)
Diastolic BP, mm Hg	78.41	79.10	80.12	80.48
	(10.55)	(10.47)	(10.76)	(10.68)
Self-reported health, 1-4	2.14	2.20	2.27	2.30
	(0.70)	(0.76)	(0.78)	(0.78)
Migration index, 0-9	0.25	0.30	0.38	0.50
	(0.59)	(0.66)	(0.76)	(0.89)
Months away, months	0.97	0.92	1.91	2.21
	(9.61)	(5.55)	(9.57)	(14.08)
Divorced, %	0.86	1.31	1.64	1.85
	(9.25)	(11.41)	(12.70)	(13.48)
Age, years	42.79	44.05	46.90	47.52
	(15.16)	(14.86)	(14.69)	(14.37
Education, 0-6	1.78	1.92	1.99	2.07
	(1.13)	(1.19)	(1.20)	(1.21)
BMI, kg/m^2	22.25	22.79	23.05	23.22
	(2.97)	(3.12)	(3.21)	(3.24)
Cigarettes per day	12.12	11.90	11.51	11.35
	(9.99)	(11.06)	(10.07)	(10.31)
Alcohol consumption. Index	11.41	14.09	13.49	13.15
	(14.30)	(16.41)	(15.18)	(15.50)
Women:				
Systolic BP, mm Hg	119.1	119.8	121.9	121.1
	(19.3)	(19.1)	(19.7)	(18.8)
Diastolic BP, mm Hg	75.93	76.33	77.21	77.30
	(10.93)	(11.15)	(11.28)	(10.86)
Self-reported health, 1-4	2.23	2.34	2.41	2.43
	(0.72)	(0.77)	(0.80)	(0.78)
Migration index, 0-9	0.07	0.09	0.12	0.17
	(0.28)	(0.31)	(0.38)	(0.48)
Months away, months	0.25	0.43	1.13	0.98
	(2.57)	(3.97)	(9.48)	(6.15)
Divorced, %	2.51	2.59	3.02	3.07
	(15.66)	(15.91)	(17.11)	(17.27)
Age, years	44.47	45.55	47.72	48.35
	(14.77)	(14.60)	(14.47)	(14.29)
Education, 0-6	1.30	1.46	1.51	1.61
	(1.16)	(1.23)	(1.24)	(1.26)
BMI, kg/m^2	22.62	23.08	23.30	23.35
	(3.26)	(3.36)	(3.53)	(3.45)
Cigarettes per day	0.88	0.85	0.75	0.74
	(3.59)	(3.50)	(3.33)	(3.37)
Alcohol consumption. Index	5.27	7.85	6.37	5.57
	(9.16)	(14.21)	(10.44)	(6.60)

[1] The data on 4784 men and 4592 women were available in 1989; for remaining years, available observations were used to compute sample means.

3.2Empirical models and econometric methods

It is important to analyze the inter-relationships among internal migration, marital dissolution, and health status in a comprehensive framework. Empirical models and econometric methods in this dissertation tackled three sets of issues.

First, internal migration is an important explanatory variable for outcomes such as health status. However, it is also plausible that individuals' migration durations are correlated with errors affecting models for health status. For example, the extent to which migrants can work under difficult conditions depends on their health status (e.g. Mou et al., 2013). Previous research on China has not simultaneously addressed such issues. For example, Tong and Piotrowski (2012) explained the chances of internal migration by variables such as self-reported health status using the CHNS data. Chen et al. (2015) explained self-reported health of the left-behind spouses, and migration was measured with a dichotomous indicator. In the present analysis, such issues were tackled using econometric methods for longitudinal data (Bhargava & Sargan, 1983) that postulate dependence of individuals' chances of divorce and health status on the lengths of periods for which they were away.

Second, it has been argued that marriage has several benefits for individuals' health and happiness in countries like the US and that divorce often has adverse consequences (e.g. Waite & Gallagher, 2000). However, such analytical frameworks may not extend easily to the Chinese context during 1989-2011where marriage was the universal phenomenon and divorce rates in CHNS were below 5%. This is partly because couples may not divorce unless the relationship is unbearable and divorce is often the last resort, considering the tremendous social stigma towards divorce. Thus, an indicator variable is

included for individuals who divorced during the sample period for testing if divorce had negative effects on individuals' health. In addition, dynamic models were adopted that they allow past health status to affect current health.

Third, models for systolic and diastolic blood pressure levels of men and women can provide insights into the effects of divorce on individuals' health. In addition, China is experiencing increases in obesity due to the changes in dietary patterns and lifestyles (e.g. Whang et al., 2012) that need to be taken into account in the models. Also, a high proportion of men smoke cigarettes and consume alcohol and these factors can increase blood pressure levels. Thus, comprehensive dynamic models for individuals' systolic and diastolic blood pressures can provide insights into effects of divorce. It is plausible that divorce may not significantly increase blood pressure levels and could even lower them for individuals in tense marriages. The dynamic random effects model for self-reported health status is spelled out in equation (3) and the dynamic random effects model for systolic (and diastolic) blood pressure for men (and women) is presented in equation (4):

$$\begin{aligned}(\text{self-reported health})_{it} = {} & b_0 + b_1 \ln(\text{age})_{it} + b_2[\ln(\text{age})_{it}]^2 + b_3(\text{education})_{it} \\ & + b_4 \ln(\text{Months away-men})_{it} + b_5 [\ln(\text{Months away-men})_{it}]^2 \\ & + b_6 \ln(\text{Months away-women})_{it} + b_7 [\ln(\text{Months away-women})_{it}]^2 \\ & + b_8 (\text{divorced indicator})_{it} + b_9 \ln(\text{per capita household income}) \\ & + b_{10} (\text{self-reported health})_{it-1} + u_{2it} \quad (i=1,...,N;\ t=1,\ldots,4) \qquad (3)\end{aligned}$$

$$\ln(\text{Systolic BP})_{it} = c_0 + c_1\ln(\text{age})_{it} + c_2[\ln(\text{age})_{it}]^2 + c_3(\text{education})_{it}$$
$$+ c_4 \ln(\text{Months away-men})_{it}$$
$$+ c_5 [\ln(\text{Months away-men})_{it}]^2 + c_6\ln(\text{Months away-women})_{it} +$$
$$+ c_7 [\ln(\text{Months away-women})_{it}]^2 + c_8 (\text{divorced indicator})_{it} +$$
$$+ c_9 (\text{number of cigarettes smoked per day})_{it}$$
$$+ c_{10} \ln (\text{alcohol consumption index})_{it} + c_{11} \ln (\text{BMI})_{it}$$
$$+ c_{12} \ln (\text{Systolic})_{it-1} + u_{3it} \quad (i=1,...,N;\ t=1,\ldots,4) \qquad (4)$$

Note that the dynamic models for self-reported health status and systolic and diastolic blood pressures were estimated using four time observations of individuals during 1997-2006. Because the estimation methods required "balanced panels," there was a reduction in the sample sizes that was likely to affect the coefficients of the constant terms in the models (Wang, Wang & Carroll, 1997). Previous levels of blood pressure were postulated to affect the current levels (Bhargava, 2003b) thereby enabling a distinction between short and long run effects of explanatory variables. For example, the short run "elasticity" (percentage change in the dependent variable resulting from a one percent change in an explanatory variable) of systolic blood pressure with respect to BMI was C_{11}, whereas the long run elasticity was $[c_{11}/(1- c_{12})]$. In addition, the length of migration in self-reported health status models is replaced by the migration index in Specification 2 in order to draw comparison on these two measures of migration.

Dynamic random effects models for self-reported health status and systolic and diastolic blood pressures were estimated by maximum likelihood methods. The statistical distribution theory assumed that the number of individuals (N) was large but number of

time periods (T) was small. Previous observations on dependent variables such as individuals' blood pressures were treated as correlated with the errors ("endogenous") (Anderson and Hsiao, 198; Bhargava & Sargan, 1983). Realizations of certain time varying explanatory variables in different survey rounds were assumed uncorrelated with the errors ("exogenous"). The errors (u_{2it}) were assumed independent across individuals but correlated over time with a positive definite variance-covariance matrix. The random effects decomposition in equation (2) was a special case, and the null hypothesis was tested using likelihood ratio tests.

Further, certain explanatory variables in the model in equations (3) and (4) might be correlated with the random effects (δ_i). In the model for systolic blood pressure, for example, the number of months that individuals were away from home could be correlated with individual-specific random effects. Maximum likelihood methods can be used to consistently estimate the model parameters and test the "exogeneity" null hypothesis for the migration durations. The null hypothesis of no correlation between random effects and migration durations was tested in the models for systolic and diastolic blood pressures. Given four time observations for the estimation, the likelihood ratio statistic was distributed for large N as a Chi-square variable with four degrees of freedom.

Table 19: Dynamic random effects models for self-reported health status of men and women for the period 1997-2006 from the CHNS [1]

	Dependent variable: Self-reported health, 1-4 [2]			
	Men		Women	
Explanatory variables:	Specification 1	Specification 2	Specification 1	Specification 2
ln (Age), years	0.098 (0.001)***	0.146 (0.001)***	-0.322 (0.018)***	-0.364 (0.017)***
[ln (Age)]^2	-0.050 (0.0003)***	-0.058 (0.0003)***	0.013 (0.009)	0.018 (0.006)***
Education group, 0-6	0.011 (0.002)***	0.012 (0.002)***	0.024 (0.006)***	0.021 (0.006)***
ln (Months away-men), months	0.036 (0.006)***	-	-0.096 (0.048)**	-
ln (Months away-women), months	-0.031 (0.008)***	-	0.049 (0.043)	-
[ln (Months away-men)]^2	-0.006 (0.002)***	-	0.009 (0.005)*	-
[ln (Months away-women)]^2	0.019 (0.001)***	-	0.013 (0.006)**	-
Migration index-men, n	-	0.027 (0.010)***	-	0.025 (0.022)
Migration index-women, n	-	-0.021 (0.012)*	-	-0.006 (0.032)
[Migration index-men]^2	-	0.002 (0.004)	-	-0.012 (0.009)
[Migration index-women]^2	-	-0.003 (0.006)	-	0.008 (0.017)
Divorced indicator, 0-1	-0.033 (0.033)	-0.032 (0.038)	-0.009 (0.027)	-0.005 (0.027)
ln (Per capita Household income), yuan	0.019 (0.001)***	0.020 (0.001)***	0.005 (0.002)**	0.020 (0.006)***
Lagged dependent variable	0.736 (0.004)***	0.713 (0.002)***	0.755 (0.069)***	0.751 (0.067)***
Constant	0.829 (0.005)	0.829 (0.005)	1.493 (0.225)	1.506 (0.219)
2 x Maximized log-likelihood function	12776.23	12785.43	12342.02	12348.22
Chi-square (8) test for random effects decomp [3]	130.66*	128.06*	140.68*	161.25*

[1] Slope coefficients and standard errors are reported for 3622 men and 3627 women; dynamic models were estimated by maximum likelihood method using a numerical optimization scheme.
[2] Higher values reflect better health status.
[3] Chi-square (8) statistic for testing the validity of the simple random effects decomposition in equation (2).
* denotes significant at 10% level, ** denotes significant at 5% level and *** denotes significant at 1% level.

Table 20: Dynamic random effects models for the systolic and diastolic blood pressure of men and women for the period 1997-2006 from the CHNS [1]

	Men		Women	
Explanatory variables:	Systolic BP	Diastolic BP	Systolic BP	Diastolic BP
ln (Age), years	-0.915 (0.002)***	-0.128 (0.002)***	-0. 711 (0.001)***	-0.043 (0.001)***
[ln (Age)]^2	0.138 (0.001)***	0.024 (0.001)***	0.113 (0.0002)***	0.015 (0.001)***
Education group, 0-6	-0.001 (0.002)	0.0001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
ln (Months away-men), months	-0.007 (0.005)	-0.011 (0.005)**	0.002 (0.003)	-0.004 (0.007)
ln (Months away-women), months	-0.003 (0.005)	-0.004 (0.006)	-0.011 (0.004)***	-0.013 (0.004)***
[ln (Months away-men)]^2	0.001 (0.001)	0.001 (0.002)	-0.001 (0.001)	0.0003 (0.002)
[ln (Months away-women)]^2	0.001 (0.002)	0.001 (0.002)	0.003 (0.001)***	0.003 (0.001)***
Divorced indicator, 0-1	-0.016 (0.008)***	-0.006 (0.008)	-0.005 (0.006)	-0.003 (0.006)
Number of cigarettes smoked per day	0.0001 (0.001)	0.0001 (0.0001)	0.001 (0.0003)***	0.001 (0.0003)***
ln (Alcohol consumption index), n	0.002 (0.001)**	0.001 (0.001)	0.001 (0.002)	-0.002 (0.003)
ln (BMI), kg/m^2	0.208 (0.009)***	0.213 (0.001)***	0.186 (0.001)***	0.172 (0.009)***
Lagged dependent variable	0.280 (0.001)***	0.243 (0.003)***	0.331 (0.001)***	0.357 (0.005)***
Constant	4.298 (0.024)	2.791 (0.015)	3.679 (0.001)	2.21 (0.009)
2 x Maximized log-likelihood function	68034.02	65371.21	69265.62	67845.45
Chi-square (8) test for random effects decomp [2]	42.87*	59.02*	84.85*	92.70*
Chi-square(4) test of exogeneity of months away[3]	4.19	10.08*	2.01	0.53

[1] Slope coefficients and standard errors are reported for 3661 men and 3829 women; dynamic models were estimated by maximum likelihood method using a numerical optimization scheme.

[2] Chi-square (8) statistic for testing the validity of the simple random effects decomposition in equation (2).

[3] Test for null hypothesis that men's (women's) months away were correlated with the random effects.

* denotes significant at 10% level, ** denotes significant at 5% level and *** denotes significant at 1% level

3.3 Results from dynamic random effects models for self-reported health status

Table 19 reports results from dynamic random effects models for self-reported health status of men and women in 1997-2006. Specifications 1 and 2 included the number of months that men and women were away from home and the migration index, respectively.

First, coefficients of individuals' age and its square were estimated with opposite signs for men and women. The coefficient of age was positive for men and was negative for women, whereas squared age was estimated with negative and positive coefficients for men and women, respectively.

Second, in Specification 1 for men, there were nonlinearities with respect to numbers of months that men and women spent away from home. The coefficient of men's time spent away was positive, whereas its squared was estimated with a negative coefficient. By contrast, the coefficient of wives' time spent away in Specification 1 was negative, while its square was estimated with a positive coefficient. Thus, it appears that wives' time spent away from home was likely to negatively affect men's self-reported health status though this effected declined with duration of separation periods.

Third, in Specification 1 for women, the coefficient of husbands' time spent away from home was negatively and significantly associated with women's self-reported health status. The coefficient of months that women were away was not a significant predictor of their self-reported health in Specification 1. In contrast with these findings, the coefficient of migration index was significant only in Specification 2 for men. The coefficient of migration index and its squared term were not statistically significant in the remaining models in Table 19. These findings underscore the need in future research for more

elaborate data for investigating the effects of time spent away from home (see the Discussion).

Fourth, coefficients of the indicator variables for whether men and women divorced during 1997-2006 were estimated with negative signs but were not statistically different from zero. Thus, divorce did not have significant impact on self-reported health status. Fifth, coefficients of per capita household incomes were estimated with positive signs and were statistically significant in all models in Table 19.

Sixth, magnitudes of coefficients of the lagged self-reported health were large for men and women. Coefficients were in the neighborhood of 0.75. Thus, long run effects of the explanatory variables on self-reported health status were four times as large in magnitude. For example, while the short run impact of per capita household income on men's self-reported health in Specification 1 was about 0.02, the long-run impact was 0.08. Such correlation is not surprising because of the innate character of the same individual respondent. In other words, a pessimistic individual continued reporting lower self-rated health status and vice versa for an optimistic individual.

Lastly, likelihood ratio statistics indicated that the data for men and women should not be pooled. The simple random effects model in equation (2) was rejected using likelihood ratio statistics reported in Table 19 that were distributed in large samples as Chi-square variables with eight degrees of freedom. Errors affecting the model for self-reported health (v_{it}'s in equation (2)) were likely to be serially correlated and the maximum likelihood estimation methods tackled such problems.

3.4Results from dynamic random effects models for systolic and diastolic blood pressures

Table 20 reports results from models for systolic and diastolic blood pressures of men and women. First, there were nonlinearities with respect to age in systolic and diastolic blood pressures of men and women. For example, the derivatives of men's and women's systolic blood pressures were zero at ages 33.71 and 23.25 years, respectively. Thus, women started experiencing increases in systolic blood pressure at earlier ages than men. Similarly, the point of inflexion of diastolic blood pressure with respect to age was lower for women. The education variable was not a significant predictor of systolic and diastolic blood pressures of men and women.

Second, the number of months men were away from home was negatively and significantly associated with their diastolic blood pressure levels. Coefficient of the squared term was not statistically different from zero. The number of months that wives were away from home was not a significant predictor of men's blood pressures. These findings contrast with the significant associations between men's self-reported health status and the number of months their wives were away in Table 19. Furthermore, in models for women's systolic and diastolic blood pressures, the number of months that women were away was estimated with significant negative coefficients, whereas its square had positive and significant coefficients. Thus, women's blood pressure levels declined with the durations away from home though the inflexion points were reached at 6.25 and 8.73 months, respectively, for systolic and diastolic blood pressures. Such issues were considered in the Discussion.

Third, coefficients of the indicator variable for divorce during 1997-2006 were estimated with negative signs in the models for systolic and diastolic blood pressures of men and women. However, the coefficient was statistically different from zero only in the model for men's systolic blood pressure. These findings suggested that divorce did not have adverse effects for individuals' health reflected in blood pressure levels thereby supporting the findings from models for self-reported health in Table 19. The significant and negative effect of divorce for men's systolic blood pressure provided some support that divorce might have lowered domestic tension for couples trapped in tense marriages

Fourth, coefficients of numbers of cigarettes smoked per day were positive in the models of systolic and diastolic blood pressures of men and women. However, coefficients were statistically different from zero only in models for women. These results suggested that despite fewer women smoking cigarettes, women were more likely to be adversely affected by smoking in terms of their blood pressure. Furthermore, the index of alcohol consumption was positively and significantly associated with men's systolic blood pressure and not with women's blood pressures.

Fifth, BMI of men and women were positively and significantly associated with their systolic and diastolic blood pressure levels. Short run elasticities of systolic blood pressure with respect to BMI for men and women were 0.21 and 0.18, respectively. Corresponding long run elasticities, using the estimated coefficients of lagged dependent variables in Table 19, were 0.29 and 0.27, respectively. Thus, effects of increases in individuals' body weights were salient in models for systolic and diastolic blood pressure.

Lastly, null hypotheses that random effects affecting the model for systolic and diastolic blood pressures of men (women) were correlated with the migration length were

tested using likelihood ratio test statistics. The test statistics for systolic blood pressure of men and women in Table 20 were 4.19 and 2.01, respectively. Because the 5% critical limit of a Chi-square variable with 4 degrees of freedom is 9.49, the exogeneity null hypotheses for months away could not be rejected. The test statistics in the model for diastolic blood pressures of men and women were 10.08 and 0.53, respectively. The null hypothesis was rejected for men's diastolic blood pressure indicating that self-selection in terms of health might have played a role in determining the durations for which men were away from home. More elaborate information on migration patterns in the future, including the number of hours worked, would be useful for testing further hypotheses.

3.5Discussion of the results from the Health Models

Health status measurements

It is important to adopt an objective measure of physical health such as blood pressure in order to reveal a more accurate picture of determinants of adult physical health. Epidemiological literature and social science literature on the health of internal migrants in China reported contradictory findings partly because of the different health outcome measurements they employed. Research based on medical and epidemiological records claimed that migrants had serious health problems (Zhang, et al., 2015). Household and work place investigations in host cities showed that the migrants reported better self-evaluated health status than urban residents (Zhang, et al., 2015). Such discrepancy was also evidenced in this analysis (Table 19 and Table 20). Self-reported health may be a poor proxy for changes in physical health (Ferraro & Farmer, 1999). For example, people tend to rate their health in the same category even as their health declines with age. Trends in

self-reported health may not reflect subtle changes in underlying physical health status (Wood, Goesling, & Avellar, 2007). This analysis found considerable persistence in men's and women's self-reported health status reflected in the estimated coefficients of lagged dependent variables that were in the neighborhood of 0.75 (Table 19). Thus, blood pressure would be a more objective and more accurate measurement of physical health to reflect subtle changes. In addition, measuring health with blood pressure is useful in sheding light on how divorce affects health in the Chinese context, where blood pressures are also affected by domestic tension. Results in Table 20 provided some support that divorce has lowered domestic tension for couples trapped in tense marriages.

Internal migration and health policies

This study filled in gaps in literature on divorce-health connections and internal migrants' wellbeing. Whether China's rural–urban migration serves as an independent contributor to NCDs such as hypertension is largely unknown (Gong, Liang, & Carlton, 2012). Many scholars in chronic disease prevention research in China have focused on ageing and its effects on disease prevalence, whilst rural–urban migrants have been largely neglected. This dissertation aimed to make an explicit causal inference between internal migration and chronic disease risk in China. Models for men and women's blood pressure levels provided insights into the effects of migration durations. For example, models for women's systolic and diastolic blood pressures in Table 20 showed significant effects of the numbers of months away from home. In fact, women's systolic and diastolic blood pressure levels increased if they were away for longer than 6.25 and 8.73 months, respectively. From the perspective of future research and public policy, the availability of

detailed information in future surveys in China on durations that couples are away from home and from each other can shed light on policy issues such as the need for family leave for migrating couples, policies to end discriminatory practices toward migrant employment, policies to integrate migrants into urban social welfare schemes, and policy reforms to address health needs of migrants. For example, migrants' health status is often not effectively monitored, and their access to professional health care services remains limited. This is partly due to the institutional separation between rural and urban health care systems (Xiang, 2004). Although new insurance schemes are expanding, the majority of migrants are still not covered because of eligibility criteria or poor employer compliance (Mou et al., 2009). Even where it is available, co-payments, upfront payment for services and ceilings on coverage often deter migrants from buying insurance and from seeking care (Barnighausen et al., 2007). The monitoring and enforcement system to improve occupational health and safety in industries in which migrants are concentrated faces serious problems and needs to be improved (Liang & Xiang, 2004).

Hypertension controls at a population level

Given the massive scale of internal migration in China, the health of migrants has important implications for the larger society. This research advanced econometric methods based on comprehensive model specifications for blood pressure and provided valuable information for more effective public health policies in China, where under-diagnosis and under-treatment of hypertension is a major public health problem (He, 2016). Unless efforts are made to lower blood pressure levels in China, death rates due to CVD are likely to increase further. To achieve this goal, ongoing research is required to identify major

determinants of BP at a population level. This dissertation shed light on multiple lifestyle factors that are associated with the presence of hypertension (including drinking, smoking, and BMI) and types of personal characteristics (including gender and social economic status) that health interventions should target.

Marriage quality

One limitation of this analysis is that it focused on marital status and was not able to investigate the impact of the marriage quality due to data unavailability. I recognize that there is considerable heterogeneity in the effects of divorce on health. Divorce could have positive long-term consequences (Thoits, 1995; Wheaton, 1990). While marital quality and its measurement are beyond the scope of this dissertation, I call for future research to investigate marriage quality for a more comprehensive understanding of health-related consequences of marital dissolution in the Chinese context. That said, blood pressure levels are affected by domestic tension. Findings from this chapter concluded that divorce had no significant impact on women's blood pressure and improved men's blood pressure level, which is consistent with the claim about the marriage quality of rural families and the Escape Theory.

Conclusion

This dissertation investigated dynamic inter-relationships among internal migration, divorce, and adult physical health in China, using longitudinal data from China Health and Nutrition Survey covering more than 19,000 individuals during 1989-2011.

Analyses were built upon strong theoretical foundations such as the Social Exchange Theory, the social selection and causation theories, the resource model, and the stress model, which have been developed and rigorously tested on western populations, as shown in Chapter 1. While acknowledging that cultural differences are important, this dissertation was informed by similarities that exist across contexts (Hosegood & Madhavan, 2012) by comparing theoretical frameworks and study results between different cultural contexts. For example, applying the Social Exchange Theory to explain divorce rates in American society was an insightful practice and shed light on examining casual determinants of marital dissolution in China (Sabatelli & Ripoll, 2004). Examining sex-ratio normalization in South Korea due to urbanization and industrialization sheds light on the possible evolution of son preference in China (Das Gupta, Chung, & Li, 2009). South Africa and China have similar forms and patterns of floating populations, which not only posed methodological challenges for measurement and analysis but also induced negative impact on family members' wellbeing (Madhavan & Schatz, 2007; Hosegood & Madhavan, 2012).

That said, this disseration emphasized the complex nationwide representative longitudinal dataset, comprehensive and dynamic model specifications, and rigorous econometric methods. It filled in some of the major gaps in the literature and provided valuable information to Chinese policy makers on various public policy initiatives and reforms.

In Chapter 2, the first sets of empirical models investigated causal determinants of marital dissolution using nine waves of longitudinal data from the China Health and Nutrition Surveys during 1989-2011. China's crude divorce rates have increased dramatically since the late 1970s, from 0.33 in 1979 to 2.7 in 2014. Sparse quantitative studies investigated causal determinants of the soaring divorce rates. Existing quantitative studies either had over-simplified model specifications or were built on cross-sectional data that was not able to control for heterogeneity among couples. This dissertation filled in the gap in the marital dissolution literature in the Chinese context and used random effect probit modeling techniques to estimate how migration and other explanatory variables (such as son preference and the 2001 Amendment to the Marriage Law) influence the probability of divorce for men and women, in rural and urban areas. One of the advantages of random effect probit modeling in comparison with simple probit modeling is its ability to distinguish the two levels (i.e., within- and between-individual) of heterogeneity in estimating the probability of divorce shaped by migration level. With time-varying covariates, the models captured the time-dependence in relationships. Likelihood ratio test statistics indicated that at least one of the explanatory variables had differential impacts on divorce risks across gender and region groups. Missing values bias and attrition bias were comprehensively examined by t- test, baseline assessment, and multiple imputations. No significant bias was evidenced. Robust inferences thus can be drawn from the estimation results from the random effects probit modeling.

From the perspective of future survey and study design, to better understand effects of internal migration on family dynamics in China, it would be useful to: 1) compile data on numbers of months that men and women spend away from home and hours of labor

supply; 2) tailor study designs to improve response rates and decrease levels of attrition to minimize their impacts on central estimation results (Hosegood & Madhavan, 2012; Deeg 2002).; 3) distinguish between mortality and non-mortality-related attrition for a more accurate picture of attrition selection; and 4) compare empirical findings and theoretical frameworks among different countries and look for similarities that exist across contexts.

Some of main findings from the divorce models were, first, longer time spent away from home was associated with higher chances of divorce for both men and women. The number of months spent away from home increased divorce risks in rural areas. This phenomenon was less evident when migration indices based on dichotomous responses were employed. This analytical result sets the stage for addressing some key policy-driven questions regarding the suboptimal and involuntary "split family" strategy and high divorce rates among floating populations: how to remove barriers for floating populations to reunite with their spouses and families and how to help new rural-urban migrating families settle in and blend in urban lives. Levels of internal migration will continue to increase. The increased average age of the floating population and the bigger proportion of the floating population living in destination cities for more than 5 years indicate more internal migrants who are married might have to adopt an involuntary "split family" strategy for a longer period of time, which will in turn further increase the divorce rate. Reforms on *hukou* system are essential to facilitate migrants' reunion with their spouses and families and their ability to settle in urban areas. Reforms involve comprehensive and in-depth modification of other existing systems and policies such as education, employment, housing, medical care, social welfare, land, governmental budgeting and taxation, and operational administration. For instance, many receiving areas' local governments lack capacity to

provide sufficient public service to the high volume of the floating population. Such incapability is due to local governments' budgeting constraints and a deficiency in crossing-area transferring and the payment system for services. Some receiving area governments are less motivated to facilitate the blending in of the floating population because local governments' major income is directly linked to VAT and corporate income tax and are much less incentivized by their residents and individual consumption. Therefore, a cost sharing system among central government, local governments, corporations, and individuals needs to be laid out with clear accountabilities in order to increase local governments' capacity in providing basic public services (such as education and health care) covering the internal migration population. Rural land management and land property systems need to be innovated in order to protect rural-urban migrants' property rights and interests (2015 Report on China's Migrant Population Development).

Second, men with sons were less likely to divorce and had more stable marriages. Son preference was salient in both urban and rural areas. Combined with the inability to have more children under the one-child policy and illegal sex-selective abortions, son preference not only increased chances of marital dissolution but also created millions of missing girls in China. This led to a higher investment in boys' education in order to be competitive on the "squeezed marriage market" (Edlund, Li, Yi, & Zhang, 2009) and created vicious circles for gender inequality. Son preference results in deprivation of girls' equal opportunity for health care, nutrition, and education, which leads to women's life-long impairment in wellbeing. It also induces crimes such as women trafficking and ultimately accelerates aging problems in China. Based on the normalization of sex-ratio experience in South Korea, which has the same patriarchal family system as China and where son

preference is culturally rooted, scholars suggested that China might experience reductions in son preference as a result of China's rapid economic development, urbanization, raised education levels for women, and increased women's labor force participation (Chung & Das Gupta, 2007; Guilmoto, 2009). Das Gupta, Chung, and Li (2009) regarded the high level of circular migration to be an effective channel of diffusing new social norms of gender equality from the urban to the rural area. More importantly, the government can play an important role in promoting gender equity through effective public policies and legislation reforms (Das Gupta et al., 2009). For instance, it is still hard for Chinese women to demand their rightful inheritance regarding lineage assets such as land in rural areas due to the strong customary rules that giving land to daughters is passing land out of the lineage (Chung & Das Gupta, 2007). Without fundamentally changing the son preference, the recent relaxation of the one-child policy in China may not decrease sex ratios as much as people would expect, and divorce rates will continue to increase, especially for men without sons. Findings from this dissertation restated the impact son preference has had on marriages and families, and provided Chinese policy makers with valuable information on more effective gender-equality campaign strategies: son preference will be further reduced and a higher level of gender equality will be achieved if more interventions and media campaigns were targeted at men.

Third, enforcement of the 2001 Amendment to the Marriage Law was a significant indicator for increasing divorce rates for both genders and in both regions. The 2001 Amendment to the Marriage Law specified women's property rights and property division upon marital dissolution in greater detail. It restated rural women's rights to land and housing upon divorce, and added new articles to improve law enforcement. Implementation

guidelines made it clear that husbands would be responsible for compensating wives to maintain a basic standard of living if she were unable to after divorce (Sun &Zhao 2014). The 2001 Amendment to the Marriage Law made unilateral divorce possible in the case of domestic violence and extra-marital relationships. These two provisions are mainly used by women. The 2001 Amendment also stipulated that when a divorce was granted, the innocent party could seek damages from the guilty party (Sun &Zhao 2014). In this sense, increasing divorce rates are an inevitable result of social and individual development, where there is more liberal legal climate for divorce, lessening of the stigma attached to divorce, and more financial protection for women.

Chapter 3 focused on the dynamic inter-relationships among internal migration, divorce, and adult physical health. For example, while the extent to which migrants can work under difficult conditions might depend on their health status (e.g. Mou et al., 2013), migrant health status is likely to be influenced by the length of migration periods and can introduce feedback effects ("simultaneity") into the relationships. While divorce might have a negative impact on individual health, unhealthy individuals are also more likely to divorce (Sbarra & Nietert, 2009). Some effects of explanatory variables on various outcomes are likely to be gradual and thus require modelling with a long term frame. There is considerable heterogeneity in the circumstances facing couples. Therefore, longitudinal data is required to study these dynamic inter-relationships and comprehensive model specifications and advanced econometric methods are essential for drawing robust inference. Modelling and estimation in this chapter is perhaps among the first trying to solve the above challenges simultaneously. Dynamic random effects models for self-reported health status, systolic, and diastolic blood pressures were estimated by maximum

likelihood methods, based on nationwide representative longitudinal data from CHNS between 1997 and 2006. Overall, this study extended the application of divorce-health theories to the Chinese context and investigated the generality of divorce-health theories that were mostly built on western countries. It further elucidated the issue of heterogeneity within the married group, where spousal separation is a common living arrangement for millions of Chinese families but is rare in the western countries, and contributed to the marriage-health literature. It made an explicit causal inference between internal migration and chronic disease risks in China that is mostly missing and neglected, while scholars in chronic disease prevention research in China had focused on ageing and its effects on disease prevalence. It also set foundations and made future comparison possible with other countries such as South Africa with similar high levels of internal migration for more effective study design and survey strategies.

Some main findings from the divorce models were, first, individuals' time spent away from home is negatively associated with their spouses' self-reported health status. Women's systolic and diastolic blood pressure levels increased if they were away for longer than 6.25 and 8.73 months, respectively. Multiple factors might contribute to the negative impact of migration length on the health of migrants and their left-behind spouses. For example, rural-urban migrants were reported to have a higher incidence of infectious diseases due to unfavorable working and living conditions, low awareness of disease prevention, and lower immunization status (Fu, Xu, & Liu, 2010; Mou, Griffiths , & Fong, 2010; Abdulraheem, 2007). More migrants worked in mining, manufacturing, and construction (Chan & Griffiths, 2010), where environmental hazards contributed to occupational damage (Gransow, 2012; Liang & Xiang, 2004; Mou, et al., 2009). Migrants

were found to have higher smoking prevalence, and migratory lifestyles were found to have negative impacts on smoking initiation (Yang, Wu, & Rockett, 2009). Migrants were reported to have elevated alcohol consumption. Family disruption due to internal migration had deleterious effects on migrants' physical health as well (Hu et al., 2008; Lu, 2010). Policies and programs need to be set up to monitor migrants' health status and to improve their access to professional health care services. Health care systems need to be reformed to break the institutional separation between rural and urban (Xiang, 2004). Although new insurance schemes are expanding, the majority of migrants are still not covered because of eligibility criteria or poor employer compliance (Mou et al., 2009). High co-payments, upfront payment for services, and ceilings on coverage need to be modified to avoid deterring migrants from buying insurance and from seeking care (Barnighausen et al., 2007). The monitoring and enforcement system to improve occupational health and safety in industries in which migrants are concentrated needs to be set up and enforced (Liang & Xiang, 2004).

Second, increasing prevalence of hypertension had been reported during the last 30 years in China and was estimated at 32.5% in a most recent survey by Lewington et al. (2016). Under-diagnosis and under-treatment of hypertension is a major public health problem in China (He, 2016). No regions or subgroups were found to have satisfactory BP control (Lewington et al., 2016). Unless efforts are made to lower blood pressure levels in China, death rates due to CVD are likely to increase further. Estimation results in Chapter 3 identified some major determinants of BP at a population level. For example, smoking was associated with higher risk of hypertension for women, and drinking was associated with higher risk of hypertension for men. BMI was another direct contributor to

hypertension for both men and women. Estimation results provided valuable information to Chinese policy makers to assist in the development of more effective identification strategies and public health policies for prevention and control of hypertension through either institutional-level interventions or individual-level health promotion, with special attention paid to the socioeconomically disadvantaged subpopulation of rural-urban migrants in China.

All studies have limitations and pitfalls; this dissertation is no exception. First, although the variable of number of months away conveyed more elaborate information than the migration index based on dichotomous responses, it suffered a greater extent of missing values. In fact, multiple imputations were not applicable to impute the number of months away due to its larger missingness. In addition, CHNS changed their question pertaining to number of months individuals were away in 1997. I call for more consistent and more detailed data collection on the length of being away and hours of labor supply for a better understanding of links between internal migration and health. Second, this analysis focused on marital status *per se* and was not able to investigate the impact of marriage quality on health due to data unavailability. I recognize that there is considerable heterogeneity in the effects of divorce on health. Divorce could have positive long-term consequences (Thoits, 1995; Wheaton, 1990). Wheaton (1990) and Williams (2003) argued that the ending of a problematic marriage implied some relief. While marital quality and its measurement are beyond the scope of this dissertation, I call for future research to investigate marriage quality for a more comprehensive understanding of the health-related consequences of marital dissolution in the Chinese context. Third, note that divorce was not evidenced to have a direct negative impact on blood pressure. Extra caution is needed

when interpreting this finding. CHNS surveys were conducted at an interval of 2 to 4 years and it is possible that more acute and short-term negative impact was not captured. In addition, blood pressure is only one dimension of physical health measurement, and I call for future studies on other physical health indicators such as health risk behaviors and health insurance status for a more comprehensive understating of the link between marriage and physical health in China. Fourth, I acknowledge the importance of psychological and mental health as both an important outcome of people's well-being and a determinant of physical health. Life satisfaction declined dramatically at precisely the time of China's economic growth, and mental illness was evidenced to have increased (Graham, Zhou, & Zhang, 2015). More studies and policies are warranted on the subjective wellbeing of the socioeconomically marginalized subpopulation such as the rural-urban migrants.

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