TWO ESSAYS ON THE CHINESE LABOR MARKET

by

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A dissertation submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics

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ABSTRACT

My research includes two essays on Chinese labor markets. In the first essay, I examine how minimum wage increase impacted employment in China in 2011 and 2012, using data from China General Social Survey. I compare employment changes in provinces with large and small minimum wage increases. I find a minimum wage increase has a small and statistically insignificant negative employment effect for two at-risk groups of workers. In Eastern China, minimum wage increase has insignificantly adverse effect on both groups. But in Central and Western China, minimum wage increase positively promotes job opportunities. In the second essay, I analyze the effect of body weight on hourly wages in China by using data from China Health and Nutrition Survey. I find significantly positive effect of body weight on an individual's hourly wage for male workers. As for females, I find that body weight is negatively related to hourly wages.

Chapter 1

MINIMUM WAGE AND EMPLOYMENT IN CHINA

1.1 Introduction

The present research seeks to examine minimum-wage policies, practices and enforcement in the Chinese labor market during recent years. China's official minimum wage policy is relatively recent, being instigated in 1994. At that time, the government of China created legal guidelines for minimum wages to be established by the individual provinces. Therefore, no national-level minimum wage was established by the central Chinese government; instead, each provincial authority had the power to set a minimum wage in that area of China. Minimum-wage levels were set in the provinces according to prevailing cost of living, wage levels and other economic factors on a regional level. Another round of policy-making regarding the minimum wage occurred in China in 2004; Du and Pan (2009) indicate that significant changes regarding minimum-wage legislation and regulation in China have taken place since 2004 additionally. These changes cover distinct minimum wage levels set in each of the provinces, in addition to legal mandates and rules regarding elements such as overtime, and increased minimum wage rates for risky work and night work.

China's minimum-wage regulations and legislation occur in the context of global discourse and argument regarding the connections and relationships between minimum wage and employment. In countries and jurisdictions of varying economic development levels, there is significant controversy regarding whether minimum wage legislation are positively or negatively related to the overall effect on employment.

Minimum-wage policies serve to increase the cost of labor; therefore, there is an argument that minimum wage in any country can have a negative effect upon business in that country, as the cost of labor is linked to competitiveness on the international scale. The competitiveness of consumer goods made in China, for example, has in recent years been at least in part based upon the relatively low labor costs in China compared to other major economies in the world. Counter-arguments hold that the establishment of a minimum wage does not negatively related to employment; furthermore, the minimum wage can be considered to provide workers with some security in their jobs and in their standard of living. As there is a shift from manufacturing and industrial economies to service-based and technological industries, the minimum wage can help in this transition in terms of the shape of the economy. One possibly interesting difference between minimum wage in China and in US is that in US most minimum wage workers are in services (fast food), while in China many are in production.

The present study fills a gap in the literature as there are few existing empirical studies considering the how minimum wage affects employment in the context of China; of the published studies considering this connection, the majority are not in English. Therefore, the current study contributes to the English-language literature regarding whether China's minimum-wage regulations have overall positive or negative effects upon employment. In 2012, China started on another round of increases to minimum wages in the various provinces; in academic, political and public arenas there is significant awareness of subsequent changes to the minimum wage. However, there is little consensus regarding how such changes have affected employment in China at the local, regional, industry or national level.

Notably, minimum wage effects and policies vary groups of workers and cannot be expected to have only positive outcomes in relation to employment. This has been the case in countries other than China. A review of the literature indicates that how minimum wage affects employment is complex. A minimum wage can broadly be shown to reduce overall poverty; however, certain negative effects upon employment have also been found in certain studies. If implementation of a minimum wage is positively related to poverty for those who hold minimum wage jobs, but a negative effect on employment rates overall, the net improvement or damage to society and the economy can be ambiguous and controversial.

In the Chinese context, the situation regarding the positive or negative effects of minimum-wage policies and practices is extremely ambiguous and may be controversial. The labor market in China has significant sectors in which labor is supplied by workers migrating from rural areas into urban areas, working often on a temporary or seasonal basis. This cohort of migrant workers forms a significant proportion of the low-wage worker population in modern China. By increasing the cost of production through higher minimum wages and thereby an increase in labor costs, it can be argued that positive minimum-wage policies and regular increases further undermine an already weakened export market for modern China. In China, as in other nations enacting minimum-wage regulations and policies, there are certain effects upon international trade, domestic poverty, the rates and quality of employment and other tangential social and economic effects.

Although a large portion of the literature regarding minimum-wage implementation and its effects comes from developed nations such as the United States and various countries in Europe, it is necessary to consider the different factors and forces at play in the case of developing nations. China's economic situation is one of a still-developing economy, with certain specific circumstances that are unique to China. Therefore, the literature that is already extant concerning the minimum wage in more developed, northern and western nations may not directly apply or correlate to the Chinese situation. The literature regarding minimum wage policies and effects in developing nations and developing economies is certainly limited by comparison to the literature regarding minimum wage history and economics in more developed countries and economies where the minimum wage has been in place often for longer than it has been in China. In developing countries as a general rule, the minimum wage is directly relevant to a relatively greater number of workers, and therefore the effects of minimum-wage policy and practice may be more stark and severe than they would be in an economy where a minority of workers were earning at a minimum-wage level (Lemos 2009).

There are few empirical studies to investigate how minimum wage increases affect employment in the Chinese labor market and even fewer published in English. In this essay, I will focus on minimum wage's impact in China in 2011 and 2012 using data from the China General Social Survey. This essay fills a gap in the existing literature mainly in two aspects. First, I estimate the minimum wage increase during 2011 and 2012, which provides the latest evidence of the existing literature. Second, this is the first essay to estimate minimum wage policy impacts in China with Difference-in-difference-in-difference (DIDID) and synthetic control method.

In Section 1.2, I introduce the background of minimum wage policy in China. Section 1.3 presents a comprehensive overview of literature review on the influential works of how minimum wage affects employment in both the U.S. and China. Section

1.4 establishes the theoretical framework of assessing how minimum wage increase affect employment in China. Then Section 1.5 elaborates the data used in my dissertation. I present the study results and discussion in Section 1.6. Finally, Section 1.7 is the conclusion of this essay.

1.2 Background

After almost one century when modern minimum wage regulation was accepted, this policy came into the Chinese labor market. In this chapter, I present the background of minimum wage in China. First, I introduce the history of minimum wage in China and how minimum wages have been implemented. I then describe how minimum wage evolved in China in this new century.

1.2.1 Minimum Wage History in China

In 1993, in order to promote the development of China's socialist market economy, the former Ministry of Labor of China's government issued the Enterprise Minimum Wages Regulation. This is the first time a minimum wage concept was introduced to China, almost one hundred years after it was acknowledged in western countries. In terms of this regulation, China's government aimed to provide a more fair competition environment among enterprises. Under this regulation, it was necessary for businesses to pay the minimum wage as established in the local area of China in which they operated. Because of the tremendous gap and diversified development standard of various areas of China, this regulation required that the local labor administrative authorities are responsible for the minimum wage implementation. So that no nationwide unified minimum wage standard in the Chinese labor market and minimum wage appears in the form of monthly level. Comparatively, in the U.S., the federal government and states set the levels of minimum wage, and the minimum wage is in the form of hourly dollars.

In China, local authorities had the power to set the minimum wage on the basis of local conditions including factors like: existing average wage levels, unemployment rate, differential development relative to other regions and the cost of living in that area of China. Relatively less-developed areas of the country, with a lower cost of living, could therefore be expected to have a lower minimum wage in effect through the new regulations. In addition, this regulation specified the local administrative authority to increase the minimum wage usually one time in each year.

In 1994, the central government of China issued the Labor Law, which includes Enterprise Minimum Wage Regulation. This is the first time minimum wage policy was established in the terms of national law. In 1994, seven local administrative authorities had set local minimum wages. And then increased to twenty-four local authorities by the end of 1995. Since then, a majority of China's provinces had adopted minimum wage policy and set provincial minimum wage standards. However, with weak supervision and ambiguous adjustment, this policy was not enforced vigorously. Especially in less developed regions, both local government and enterprises were reluctant to supervise or implement this policy. Relative income level can help local enterprise to maintain comparative advantage and promote local economic development.

After ten years, in 2004, under the background of establishment of a domestic demand-led economy and continuous income gap of various cohorts of workers, central government passed new minimum wage policies. The Enterprise Minimum Wage Regulation was replaced by Minimum Wage Regulation, and then the implementation of minimum wage policy nation widely. After that, minimum wage serves as one of the most prominent symbols to monitor and adjust China's labor market by central and local administrative authorities. (Du and Pan 2009).

This new legislation extends the applicable scope that includes private (including township and village enterprises) and state-owned business enterprises which are required to pay locally-mandated minimum wages, and the coverage of policy also extended to those working in a self-employment context. The penalty for non-compliance with minimum wage regulations was increased significantly, and there was a new requirement for the provincial authorities to update minimum wage policy more than one time within every two years. The 2004 regulations also extended some coverage and protection to full-time employees – who were guaranteed a monthly minimum income – and an hourly minimum to those employed on part-time, temporary or seasonal basis. I summarize and highlight the improvements of the new edition minimum wage policy:

1. Coverage: state-owned, private enterprises and self-employed business.
2. Frequency: update the minimum wage policy more than one time within every two years.
3. Penalty: violation or noncompliance would be four times of annual minimum wage income

Two types of minimum wage:

1. Monthly minimum wage for fulltime workers
2. Hourly minimum wage for non-fulltime employees (mostly rural migrants)

Since early 2004 there have been quite frequent and significant changes of minimum wages in amount and frequency nationwide in China. I present how minimum wage changed in terms of frequency and magnitude in the next section. Although this regulation makes tremendous progress in China's labor market, it remains highly fragmented in terms of local minimum wage supervision measures and their updates and variability.

In 2008, at the national level a new labor-contract law was passed – Labor Contract Law, that requires that employers give all workers contracts in writing. Additionally, the use of temporary workers is restricted under this law, and it is more difficult for employers to enact layoffs. I use a timeline to present and highlight the pathway of how minimum wage policy evolved in China. There are three most important time points in this history: in 1994, minimum wage policy first came to China; in 2004, this policy was strengthened in many fields in terms of coverage, penalty and supervision; in 2008, the new labor law protected worker furthermore.

Figure 1.1: Minimum Wage History in China

In the next Section, I summarize and present how minimum wage changed in terms of frequency and magnitude from this new century with the latest data which were not utilized in the existing literature.

1.2.2 Minimum Wage in China

In China there is no national level of minimum wage, and local administrative authorities set minimum wage standards according to the local economic development. I calculate the national minimum wage by employing a two-step weighted approach. First, I calculate the provincial average minimum wage by how long minimum wage was effective in a year as the weight. Then, I obtain the annual average national minimum wage according to the provincial average minimum wage, and I use the provincial urban employment rates as weight. In Figure 1.2, I present the nominal and real minimum wage (in year 2000 RMB) from 2000 to 2015[1]. I find that the nominal minimum wage and the real minimum wage followed the same trend. The growing gap between nominal and real minimum wage after 2006 is because that the CPI is relatively high in that year. A modest inflation (CPI increase ranges from 2% to 6%) occurred in China for last ten years. Between 2000 and 2003, the average nominal minimum wage increased from 355 RMB to 413 RMB, which is 16.3 percent growth. With the new minimum wage policy issued in 2004, the monthly nominal minimum wage has increased dramatically to 1550 RMB (US$ 246.03) in 2015, compared to $1276 in the U.S[2].

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[1] Provincial minimum wages are published and available on official government websites.

[2] Federal minimum wage in the U.S. is $7.25 per hour. I calculate the monthly minimum wage by considering 8 hours per day and 22 working days per month.

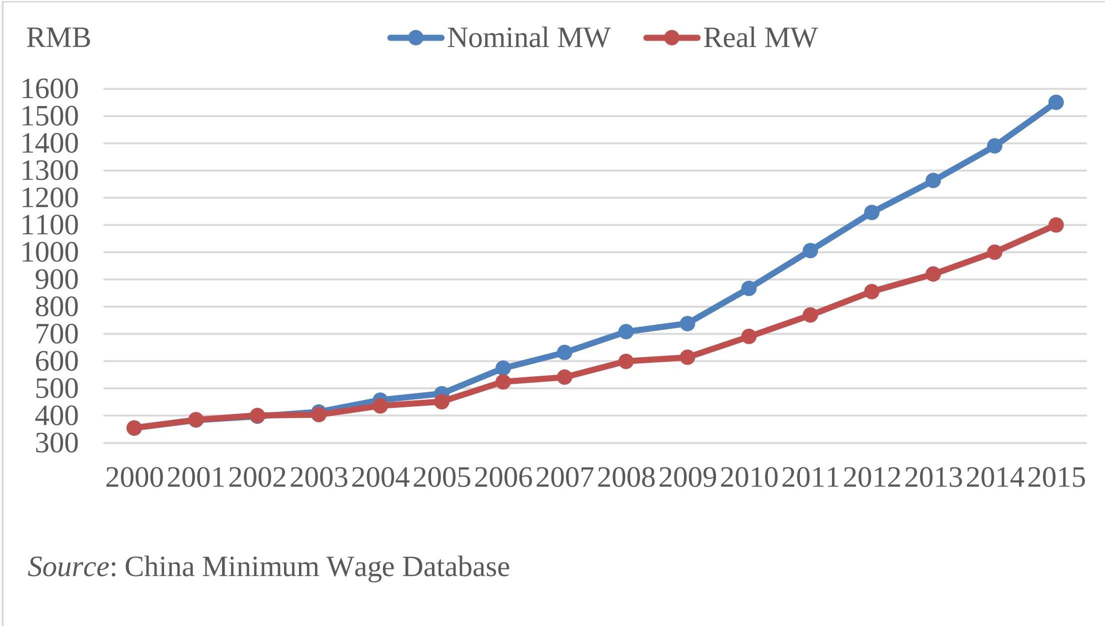

Figure 1.2: Minimum Wage in China, 2000-2015

In Figure 1.3, I show the number of provinces with minimum wage adjustment annually from 2001 to 2015. I find that the minimum wage policy adjusted more frequently after 2004, which this is the year China enacted the minimum wage law. After 2004, every year more than 20 provinces adjusted the provincial minimum wage except in 2005, 2009 and 2014. In 2009, due to the global financial crisis, minimum wage increase was frozen in each province. Then, the number with increases is steady and local government continued to promote the minimum wage policy.

Figure 1.3: Number of Provinces with Minimum Wage Adjustment 2001-2015

In Figure 1.4, I show the ratio of the minimum wage to the average wage for China and OECD countries (OECD Stat 2014)[3]. The minimum wage standard is lower in China than that of in OECD countries. During 2000 to 2015, the ratios among OECD countries have been steadily more than 35 percent, however, the relative minimum wage has declined in China and the divergence continues. The ratio was 29 percent in 2015, and has been below 32 percent for almost ten years.

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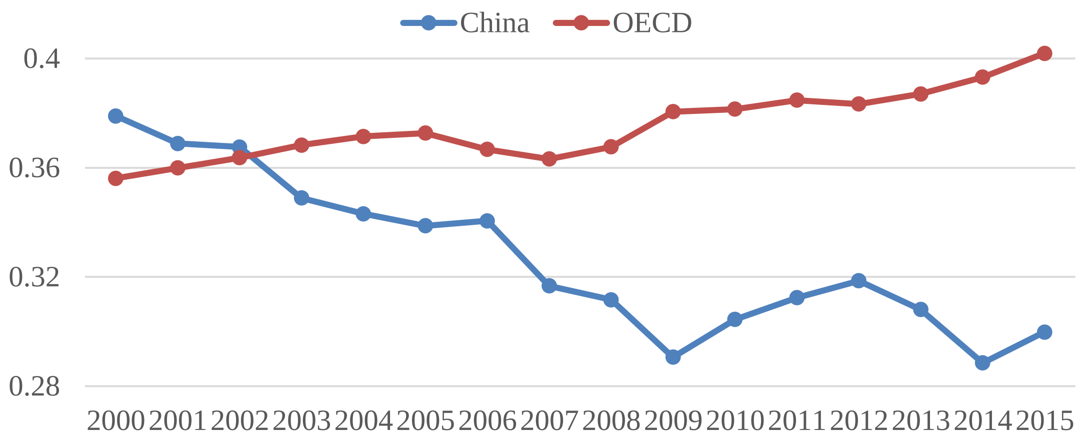
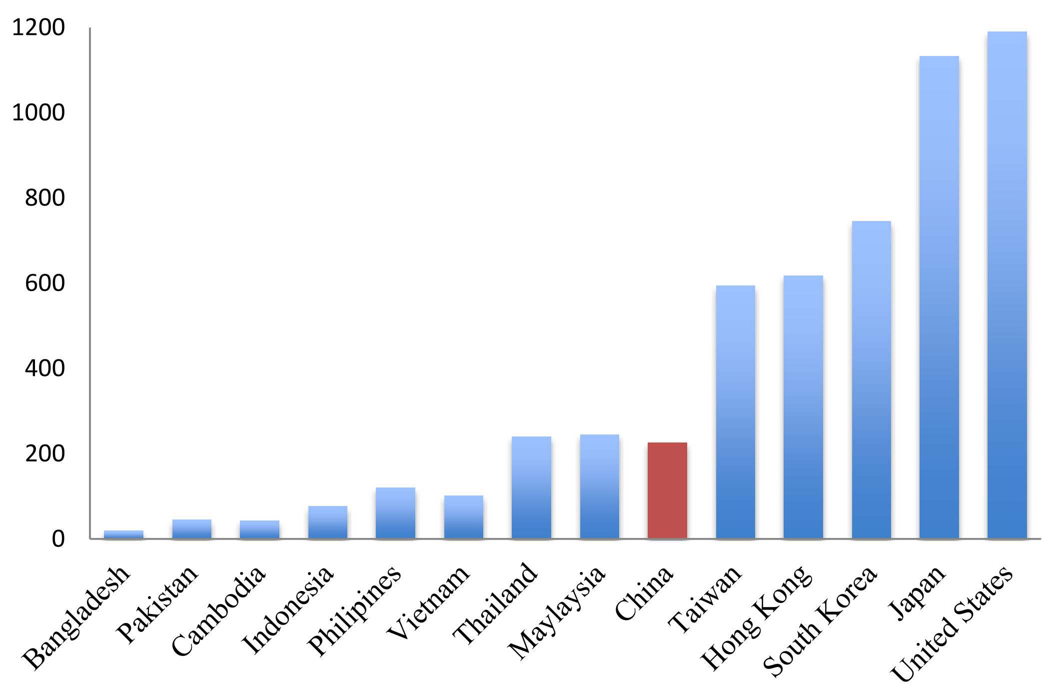
[3] Provincial average wages are published by National Bureau of Statistics of China and the websites of local administrative authorities.



Source: China Minimum Wage Database and OECD. Stat 2015

Figure 1.4: Relative Minimum Wage of China and OECD, 2000-2015

Figure 1.5 shows the minimum wage in China, other Asian countries and the U.S. in 2014 in US dollars. China's monthly minimum wage is more than $200, which is larger than in countries in East and South Asia, but is lower than in her neighboring Asian countries. Although the monthly minimum wage is generally one fifth of that in Japan and the U.S., Chinese minimum wage workers earn more than workers in Vietnam and Bangladesh. That is why low cost and labor intensive industries such as shoe and garments manufacturing have transferred some productions to those cheaper locations. For example, manufacturer giants Nike and Adidas left from China four years ago, and transplanted their factories from China to Vietnam and Indonesia, where labor income is relatively lower than in China.



Source: China Labor Bulletin (CLB) 2014

Figure 1.5: Monthly Minimum Wage Levels in Asia and the U.S. 2014 (US$)

As I mentioned before, the minimum wage standard is not national in China. The provincial administrative setup involves provincial monthly minimum wages based on local economic development. Therefore, each provincial monthly minimum wages differ dramatically. In Table 1.1 I list the monthly minimum wage from each province from 2011 to 2015 in China, and this scenario provides us an opportunity to investigate how minimum wage increases affect employment through a natural experiment, because in the same time period, some provinces increased their monthly minimum wages, while others did not.

Table 1.1: Provincial Monthly Minimum Wages from 2011 to 2015 in China (RMB)

	2011	2012	2013	2014	2015
Eastern					
Beijing	1160	1260	1400	1560	1720
Tianjin	1160	1310	1500	1680	1850
Hebei	1100	1320	1320	1480	1480
Liaoning	1100	1100	1300	1300	1530
Shanghai	1280	1450	1620	1820	2020
Jiangsu	1140	1320	1480	1630	1630
Zhejiang	1310	1310	1470	1650	1860
Fujian	1100	1200	1320	1320	1500
Shandong	1100	1240	1380	1500	1600
Guangdong	1300	1300	1550	1550	1895
Hainan	830	1050	1120	1120	1270
Central					
Heilongjiang	880	1160	1160	1160	1480
Jilin	1000	1150	1320	1320	1480
Shanxi	980	1125	1290	1450	1620
Anhui	1010	1010	1260	1260	1520
Jiangxi	720	870	1230	1390	1530
Henan	1080	1080	1240	1400	1600
Hubei	1100	1100	1300	1300	1550
Hunan	1020	1160	1265	1265	1390
Western					
Sichuan	850	1050	1200	1400	1500
Chongqing	870	1050	1050	1250	1250
Guizhou	930	930	1030	1250	1600
Yunnan	950	1100	1265	1420	1570
Shaanxi	860	1000	1150	1280	1480
Gansu	760	980	1200	1350	1470
Qinghai	920	1070	1070	1270	1270
Ningxia	900	1100	1300	1300	1480
Xinjiang	960	1340	1520	1520	1670
Guangxi	820	1000	1200	1200	1400
Inner Mongolia	1050	1200	1350	1500	1640
Tibet	950	1200	1200	1200	1400

Source: China Minimum Wage Database

1.3 Literature Review

Minimum wage increase affecting employment is the keystone to evaluate many economic factors, such as wage distribution and human capital. In western countries, many scholars have focused on this issue theoretically and empirically over several decades.

Theoretically, how minimum wage increase affecting employment is ambiguous depending on whether the labor market is competitive or a monopsony. In a perfectly competitive labor market, labor supply and demand curve intersect and generate the equilibrium wage, which is equal to the marginal product of labor. If minimum wage is higher than the equilibrium wage , adverse employment effect would be observed, because the increased wage forces employers to lay off workers whose marginal product value is lower than the minimum; and also the higher wage attracts more workers entering the labor market and increases labor supply. Therefore, minimum wage increase will lead to reductions in employment and increases in unemployment.

In a monopsony market model, firms have power to affect wage rates. In this model, both the employment and the wage level are smaller than that in the competitive market. If the initial minimum wage standard is lower than the market clearing wage, employment would increase and the effect is positive, which is the opposite of the result in a competitive market model.

1.3.1 Empirical Studies in the U.S.

The literature in the U.S. on the topic of how minimum wage increases affect employment is a huge amount. Before 1990s, a large number of literature used time-series analysis of national employment rates for typical groups such as teenagers (Card and Krueger 1995; Brown 1999). This method investigated an average minimum wage effect on employment for a certain time range, and concluded that if minimum wage increases 10 percent, employment would decrease 1-3 percent and the effect is statistically significant (Neumark and Wascher 2006).

The recent studies after the 1990s which include both time series and cross section data of geographic units, industries, and demographic groups and found that negative employment effects which larger than previous 1-3 percent and even statistically insignificant positive effect, while the most found is with negative and insignificant employment effect (Neumark and Wascher 2006).

I focus on the literature from the 1990s and later which is more meaningful to this essay. Katz and Krueger (1992) explored how minimum wage increased in Texas in1991 affect employment in fast food restaurants. They used OLS estimates of reduced form models and 2SLS estimates of models based on the longitudinal survey data. The instrumental variable used in their study is the actual change in the log starting wage. They found that minimum wage had positive effects on employment and the effect is significant at the 10 percent level with the estimated elasticity 1.70 to 1.85.

Card (1992) employed state variation in average wage levels to examine how federal minimum wage increased in April 1990 affected teenagers' wages, employment and school enrollment. He used the monthly files of CPS data in 1989 and 1990. He pioneered used "natural experiment" intuitive in his minimum wage research, and he focused on that treatment effect are different among states. He found that minimum wage increase promoted teenagers' wages and he found no evidence related to negative effects on teenage employment or school enrollment.

The most influential study on the U.S. minimum wage is by Card and Krueger (1994), who employed a natural experiment to analyze the minimum wage difference with New Jersey and Pennsylvania in 1992 to identify the minimum wage effect. The hourly minimum wage increased \$0.8 in New Jersey in April 1992 and the adjacent state of Pennsylvania maintained its hourly minimum wage standard at the same time. They interviewed more than four hundreds fast food restaurants in New Jersey and eastern Pennsylvania during the minimum wage increased. They compared employment growth among these restaurants in both states and they compared employment changes at restaurants with initially paying high wages to that lower wage stores in New Jersey State only. They found that fast food restaurants which are located in New Jersey increased employment by 13 percent relative to stores in Pennsylvania. This result was potentially contradictory to conventional empirical studies and theoretical analysis.

Neumark and Wascher (2000) re-analyzed Card and Krueger's (2000) study by employing an alternative data from payroll records from 230 fast-food restaurants in these two states. They used the same difference-in-difference (DID) method and found that employment effect is negative and significant in New Jersey in 1992, which contradicts the results from Card and Krueger's (1994) research. Card and Krueger (2000) replied to Neumark and Wascher's (2000) contrasting findings and further investigated the NJ-PA natural experiment by using the Bureau of Labor Statistics data, which include longitudinal and a series of repeated cross sections data. Through

DID and regression-adjusted mode, they claimed that the minimum wage increase in New Jersey in 1992 had no statistically significant negative effect. They conceded that the effect was probably not positive.

Hoffman and Trace (2009), who used CPS data and investigated how federal minimum wage increased $0.9 in 1996 and 1997 affect employment changes in New Jersey and Pennsylvania. Here Pennsylvania's minimum wage went up but New Jersey's did not, which was contradictory to the earlier case. Unlike Card and Krueger who focused only on fast-food restaurants, the authors examined impacts on typical groups by age and education to identify which groups are easily to be affect by minimum wage increased. They use DID and DIDID methods and found negative employment results, especially for non-teens with no high school education.

Dube, Lester and Reich (2010) examined employment and earning effects in restaurants and other low-wage sectors for minimum wage increased during 1990 and 2006, where occurred in across border counties. They used the data from the Quarterly Census of Employment and Wages between 1990 and 2006 and found no negative employment effects. They also claimed that conventional studies were weakened by lack of consideration of spatial heterogeneities in employment trends so that these lead to spurious negative employment effects.

Hoffman (2014) examined how federal minimum wage increased in 2009 affect employment changes of low-skill workers with their affected and unaffected peers in and across states where the state minimum wage increased (treatment group) and other did not increase (control group). He used 2009 CPS data and found little negative employment effects evidence for typical groups: teens without college education and adults without high school education by using DID and DIDID technique.

Hoffman (2016) questioned the results from Sabia, Burkhauser and Hansen (2012). Instead of using the smaller data size CPS-MORG, he used the full CPS survey data. He used the same research method and re-analyzed SBH New York State experiment, and did not find any negative employment effect of minimum wage increase. He also questioned the potential treatment unit in the Sabia, Burkhauser and Hansen study and employed 3 states and the Washington D.C. as treatment group, and a small positive employment effect was found.

Clemens and Withers (2014) focused on minimum wage increased by $2.1 during the Great Recession and examine how the increase affected the employment and income trajectories of low-skilled workers. They employed two sources of data: panel data from the Survey of Income and Program Participation in 2008 and the CPS. They compared individuals in bound states to those in unbound. They constructed target and within-state control (baseline wages moderately higher than the new federal minimum) groups as minimum wage varies across the skill groups. They found that the minimum wage had a significantly negative effect of low-skilled workers. Through the monthly and individual level panel SIPP data, they claimed that the average monthly incomes of low skilled workers were reduced by minimum wage increased.

1.3.2 Empirical Studies in China

Minimum wage policy have been introduced in China about two decades, and the empirical study has begun from the new century. Research on this topic is not as huge amount as in western countries. Because the unbalanced development in different regions and coexistence of various ownership firms (state-owned and others), the existing literature can be categorized as: study based on macro data and use time series models and study based on individual cross-sectional data. Minimum wage effect on employment is still mixed in the existing literature.

1.3.2.1 Macro-data Studies

Wang and Gunderson (2011) focused on migrant workers and estimated the employment effects of minimum wage during 2000-2007. Based on annual China Population Statistics Yearbook and annual China Statistics Yearbook aggregate data, they utilized an estimation technique proposed by Neumark (2001), which includes minimum wage and one-year lagged value as independent variables. The lagged response to minimum wage is expected to be greater than the contemporaneous response. Dummy variables for year and province are included to control for potential unobserved factors. They estimated the model separately for workers in all enterprises and for non-state and state-owned enterprises. They found a negative employment effect in less-developed regions (central and western China) and larger negative effects in non-state-owned companies that tend to be more sensitive to market pressures. In contrast, they did not find negative employment effects in the growing and prosperous eastern China and positive employment effect was found in state-owned industries in that region.

Wang and Gunderson (2012) estimated how minimum wage affected employment and wage in ten eastern provinces of China in 2003 by using difference-in-difference (DID) technique. The minimum wage increased in six eastern provinces, which are the treatment group, and four other provinces are the control group. They focus on typical groups and sectors where minimum wage might affected easily. They found a statistically insignificant negative employment effect of -0.15% for all workers. The adverse effects are larger for women who are in the low income sectors; the magnitude of impact is -0.51% but still statistically insignificant. While this paper appears to be the first research as the minimum wage effect in China using DID method, the authors did not identify which province was in treatment or control group.

Ni, Wang and Yao (2011) examined how minimum wage affected employment in China during 2000 to 2005 by employing provincial data. Similar to the method used by Wang and Gunderson (2011), they used the current minimum wage and one year lag minimum wage as independent variables. They found that the minimum wage increase has positive and genative effects on employment and the results differ within three regions. In eastern China, they found negative employment effect, despite the fact that the effect is statistically insignificant in eastern China; contradictory, they found slightly positive employment effect in the central and western regions. Work hours and wage effects are not estimated in this paper.

Wang and Yao (2014) investigated how minimum wage policy affects employment in thirty provinces from 2000-2010 by using macro aggregate panel data from the China Labor Statistics Year Book. They used minimum wage level, GDP, CPI, unemployment rate and population as independent variables to explore how the minimum wage affects employment. They claimed that if minimum wage increases 10%, the overall employment rate (employed people divided by population) decreases by 2.3%.

1.3.2.2 Micro-data Studies

Jia (2014) employed DID methodology to investigate how minimum wage affected employment and working hours of workers with low education level (defined as less than high school education). In 2005, minimum wage increased in 23 provinces (treatment group) and did not increase in other provinces (control group). He used data from China General Social Survey (2005-2006) and compared the employment and working hours. He also used a regression including individual demographic factors to estimate the minimum wage impact by gender. He found that the minimum wage increase has no effect on the employment changes of male workers; meanwhile, the minimum wage increase had a significantly negative effect on female workers employment but had no influence on their working hours.

Fang and Lin (2013) estimated how minimum wage affected employment for urban workers over the period 2004-2009. They used the annual China Urban Household Survey data and focus on young (15-29) and low-skilled workers (below high school graduate) in 16 representative provinces (eastern, central and western). Based on the panel data, the authors employed the same technique proposed by Neumark (2001) and Wang and Gunderson (2011). They find that minimum wage has significant negative effects on young urban workers' employment. They also assess the effect by gender and age and find negative effect on female young workers, but no effects on their male counterparts. They do not estimate other impacts, like work hours or wage effects.

Ding (2010) examined survey data from more than four hundreds companies in two eastern provinces in 2008. He found that a minimum wage increase had a significant negative impact on migrant workers employment, while no significant change was observed among urban workers. He also found that the labor contract law in 2008 improved the regulatory of labor market and led to more influence on migrant workers.

Ma and Zhang (2012) examined how minimum wage increases affect employment and wages during 1998 to 2007. They used the data from the Annual Survey of Industrial Firms (ASIF) to analyze the minimum wage influence by using OLS equation. They claimed if minimum wage increase 10 percent, average wages would increase by 0.3 to 0.6 percent, workers in labor intensive firms would benefit more than others. They also found that minimum wage policy decreased employment, if minimum wage increase by 10 percent, employment would decrease by 0.6 percent.

Ma (2016) analyzed how minimum wage policy impacted the wage distribution of workers from the private and public sectors separately in urban China. The author used panel data from the Chinese Household Income Project Survey (CHIP) and an ordinary least squares model to estimate how a minimum wage affect the wage distribution both in the private and public sectors for three periods. The author found that the effect is greater for the private sector than for the public sector; and the effect is continuously growing in the latest period (2007-2013), which implies that minimum wage policy compliance has become stronger gradually.

The existing literature in China is all based on the minimum wage policy before the 2008 global financial crisis. After that time, the magnitude and frequency of minimum wages has been increased substantially in each province. In this essay, I contribute to existing study: first, my analysis focuses on the minimum wage policy interventions to provide more timely evidence; second, DIDID and synthetic control method are first employed to investigate how minimum wage increases impact employment.

1.4 Methodology

In this section, I introduce the empirical strategy to analyze how minimum wage increases affect employment. A minimum wage increase is considered as a natural experiment and I pin down the experiment time period, experiment and control group. I will follow the basic technique of Hoffman (2014) to use difference in difference (DID) and difference-in-difference-in-difference (DIDID) technique to estimate how minimum wage affects employment. And I also use linear regression to estimate the employment effect by control covariates. Finally, I employ synthetic control method (SCM) to investigate how minimum wage increases affect employment in China.

In my dissertation, I will focus on the minimum wage policy intervention after 2008 and provide the latest study outcomes to the existing literature. Because of the global financial crisis, China's provincial minimum wage did not change during 2008 -2009. Since then, the magnitude and frequency of minimum wage has increased substantially in each province. Considering to the availability of published data, I choose the period from 2011 through 2012. Over that time period, 21 provinces increased their minimum wage while 7 provinces did not - three in the eastern region (Liaoning, Zhejiang and Guangdong), three in the central region (Anhui, Henan and Hubei), and one in the western region (Guizhou). I summarize the detailed minimum wage changes in each province during that time in Table 1.2. Seven provinces are categorized as the "control group", while the other 21 provinces are categorized as the "treatment group". There are also differences within the treatment group regarding the size of the minimum wage increase. I will discuss that later.

From Table 1.2, the overall highest minimum wage increase rate in the treatment group is in Xinjiang (39.5%), and the least is in Beijing (8.6%). Hainan has the highest increase (26.5%) in the eastern region, Heilongjiang (31.8%) in the central region, and Xinjiang (39.5%) in the western region. Xinjiang also has the highest absolute growth (380RMB). The average increase for all provinces in the treatment experiment group is 18.7%, and for each region is: 14.9% (eastern), 18.52% (central) and 22.6% (western). The 2011 level of the minimum wage in the eastern region (coastal region) is relatively higher; comparatively, the minimum wage level in less developed regions (western and central) is lower, which indicates unbalanced economic development between eastern and other regions. Beijing has the lowest increase rate with 8.6%, one fourth of Xinjiang's growth. Shanghai has the highest minimum wage standard (1450 RMB) in 2012 and the increase is 13.3%, one third of Xinjiang's growth rate. The tremendous divergence in minimum wage standards indicate that the economic and social development is dramatically different in each region of China.

Table 1.2: Chinese Provinces by Increase in Monthly Minimum Wage, 2011-2012

Treatment Group				**Control Group**	
	2011	2012	Increase %	2011-2012	
Eastern Region					
Beijing	1160	1260	8.6%	Liaoning	1100
Tianjin	1160	1310	12.9%	Zhejiang	1310
Hebei	1100	1320	20%	Guangdong	1300
Shanghai	1280	1450	13.3%		
Jiangsu	1140	1320	15.8%		
Fujian	1100	1200	9.1%		
Shandong	1100	1240	12.7%		
Hainan	830	1050	26.5%		
Average	1109	1269	14.9%		1237
Central Region					
Heilongjiang	880	1160	31.8%	Anhui	1010
Jilin	1000	1150	11.5%	Henan	1080
Shanxi	980	1125	14.8%	Hubei	1100
Jiangxi	720	870	20.8%		
Hunan	1020	1160	13.7%		
Average	920	1093	18.5%		1063
Western Region					
Sichuan	850	1050	23.5%	Guizhou	930
Chongqing	870	1050	20.7%		
Yunnan	950	1100	15.8%		
Shannxi	860	1000	16.3%		
Gansu	760	980	28.9%		
Xinjiang	960	1340	39.5%		
Guangxi	820	1000	21.9%		
Inner Mongolia	1050	1200	14.3%		
Average	791	969	22.6%		930

Source: Author’s calculation based on the China Minimum Wage Database

I also compare the ratios of provincial minimum wage and average wage for 2011 and 2012 in Table1.3. Table 1.3 shows that the ratio declines in control group provinces, but it is either constant or increases in treatment group provinces. Since each province sets its own minimum wage, just knowing that the minimum wage went up in some provinces but not in others might not be enough, if the minimum wage went up by less than average wages or if average wages fell in the control group. From Table 1.3, for the provinces in the treatment group the average ratio of minimum wage and average wage in 2012 is 1.92 percentage point higher than the ratio in 2011. That means the minimum wage increase in these provinces is relatively higher than average wage increase for the same time. In control group provinces, the average ratio declined 3.74 percentage points. Together, Table 1.2 and 1.3 show that the minimum increases are real, relative to wage growth in that province.

Table 1.3: Ratio of Monthly Minimum Wage and Average Wage by Province, China, 2011-2012

Treatment Group				Control Group			
	2011	2012	difference		2011	2012	difference
Eastern Region							
Beijing	24.83%	24.12%	-0.71%	Liaoning	34.10%	31.06%	-3.04%
Tianjin	32.95%	33.83%	0.88%	Zhejiang	43.99%	39.22%	-4.77%
Hebei	36.50%	40.97%	4.47%	Guangdong	34.55%	30.84%	-3.71%
Shanghai	29.55%	30.90%	1.35%				
Jiangsu	29.75%	31.28%	1.53%				
Fujian	33.86%	32.02%	-1.84%				
Shandong	35.92%	35.89%	-0.03%				
Hainan	27.12%	31.46%	4.34%				
Average Ratio	31.31%	32.56%	1.25%				
Central Region							
Heilongjiang	31.52%	40.80%	9.28%	Anhui	29.82%	26.30%	-3.52%
Jilin	35.09%	35.93%	0.84%	Henan	37.89%	34.14%	-3.75%
Shanxi	29.47%	30.52%	1.05%	Hubei	35.66%	32.29%	-3.37%
Jiangxi	25.37%	26.33%	0.96%				
Hunan	34.46%	34.77%	0.31%				
Average Ratio	31.18%	44.67%	2.49%				
Western Region							
Sichuan	32.39%	34.87%	2.48%	Guizhou	33.11%	29.07%	-4.04%
Chongqing	29.55%	28.32%	-1.23%				
Yunnan	32.21%	33.93%	1.72%				
Shannxi	26.44%	27.07%	0.63%				
Gansu	28.42%	35.74%	7.32%				
Xinjiang	31.96%	35.54%	3.58%				
Guangxi	28.79%	31.91%	3.12%				
Inner Mongolia	30.37%	30.60%	0.23%				
Average Ratio	30.02%	32.25%	2.23%				
All Average Ratio	30.79%	30.72%	1.92%		35.59%	31.85%	-3.74%

Source: China Minimum Wage Database

I follow the technique of Hoffman (2014) to explore how minimum wage increases affect employment. I make three kinds of difference comparisons, including two difference-in-difference (DID) comparisons - between and within provinces - and a difference-in-difference-in-difference (DIDID). Because of the wide range of changes in minimum wages shown in Table 1.2 and unbalanced economic development in different regions, I will examine DID separately by three ranges of minimum wage increases (less than 15%, 15%-25% and above 25%) and accordingly three different regions (eastern, central and western China). I use age and education as indicators to classify workers and I choose teens (age 16-19) without college education and adults (age 20-59) without high school education as at-risk groups. These two groups are likely to be affected by minimum wage increase. In terms of the within-province DID, I will compare more affected workers and workers who have higher probability of being unaffected by minimum wage increase. I choose male adults (age 30-59) with at least college education as the group which are not likely to be affected by the minimum wage increase. Because this group of people have higher working experience and more skills, they are usually paid much more than minimum wage standards and therefore minimum wage increase has no impact on this group. I will analyze the appropriateness of the chosen worker groups in the following section.

My first DID method is a between-province comparison:

$$DID_B = (E^T_{m2} - E^T_{m1}) - (E^C_{m2} - E^C_{m1}) \tag{1.1}$$

Where E_{mt} is the employment rate in time t of some group. The between-province comparison estimates the employment impact as the difference in the employment changes of workers who are likely to be affected in provinces with and without minimum wage increase.

My second DID method is a within-province comparison:

$$\mathrm{DID_w} = (\mathrm{E}^{\mathrm{T}}_{\mathrm{m2}} - \mathrm{E}^{\mathrm{T}}_{\mathrm{m1}}) - (\mathrm{E}^{\mathrm{T}}_{\mathrm{n2}} - \mathrm{E}^{\mathrm{T}}_{\mathrm{n1}}) \tag{1.2}$$

Where n is some other group of unaffected workers. The within-province comparison estimates the difference between the employment changes of workers who are easily affected with those unaffected by a minimum wage increase. These unaffected workers are usually those with more education. Similarly to the first method, within-province comparison could also be affected by omitted variable bias.

My third method uses a DIDID:

$$\mathrm{DIDID} = [(\Delta\mathrm{E}^{\mathrm{T}}_{\mathrm{m}} - \Delta\mathrm{E}^{\mathrm{T}}_{\mathrm{n}}) - (\Delta\mathrm{E}^{\mathrm{C}}_{\mathrm{m}} - \Delta\mathrm{E}^{\mathrm{C}}_{\mathrm{n}})] \tag{1.3}$$

$$\mathrm{DIDID} = [(\Delta\mathrm{E}^{\mathrm{T}}_{\mathrm{m}} - \Delta\mathrm{E}^{\mathrm{C}}_{\mathrm{m}}) - (\Delta\mathrm{E}^{\mathrm{T}}_{\mathrm{n}} - \Delta\mathrm{E}^{\mathrm{C}}_{\mathrm{n}})] \tag{1.4}$$

where Δ is the associated employment change. For equation (1.3), the first term is the within-province comparison discussed above. Equation (1.4) is equivalent to (1.3). The first term is the between-province comparison discussed above. The DIDID technique controls for unmeasured effects in Equation (1.1) and (1.2) by eliminating potential changes in the macroeconomic environment either across treatment and control provinces, or affected and unaffected workers.

Then I estimate a linear regression of the treatment effect to take covariates impact into account. The covariates includes individual demographic characteristics and provincial fixed effects:

$$E_{ipt}= \beta_0+\beta_1 Treatment_{ipt}+\beta_2 Time_{ipt}+\beta_3 Treatment_{ipt} \times Time_{ipt}+\alpha\gamma_i+\varepsilon_{ipt} \quad (1.5)$$

Here, β_3 is the treatment effect which is the parameter of my interest. Treatment and time are two dummy variables. γ_i includes full sets of demographic control variables.

1.4.1 Synthetic Control Method

Due to the greatly diversified economic development in China, treatment and potential control groups may not follow parallel trends. Abadie (2003; 2010) pioneered a synthetic control method to conduct natural experiment research. Specifically, the synthetic control method computes a time-invariant weighted average of the control group to construct a match unit for the treated group. The synthetic control unit and treated groups both have similar pre-intervention characteristics and outcome. The major difference with the DID technique is that effects of observed and unobserved predictors of the outcomes could be change during the natural experiment in the synthetic control method. In this essay, I will choose factors as predicators which can easily reflect employment rates differences to generate an aggregated single treated group and a synthetic control group, the factors include: GDP per capita, urbanization rate[4], industry index[5] and CPI.

1.5 Data and Descriptive Analysis

In this section I introduce the dataset used to examine how minimum wage increases affect the employment and describe the details of data selection. I also introduce and elaborate the dependent and independent variable used in this essay.

Minimum wages database of China

I construct a panel of provincial minimum wages from the year 2000 to 2015 with the specific effective date of each minimum wage increase. Nominal and real minimum wages are both included in the database. In this essay, I will focus on the 2011-2012 dataset.

Microeconomic Data

I use pooled cross-sectional micro-data from the China General Survey Data (CGSS). The CGSS is a cooperative database by the Department of Sociology at China Renmin University and the Division of Social Science at Hong Kong University of Science and Technology. It is a continuous comprehensive national social survey in China. This annual or biannual survey was designed to gather longitudinal data of urban and rural households on life quality and social trends in China from the year 2003. CGSS includes individual demographic information in 28 provinces in China.

[4] Urbanization rate is defined as the proportion of urban population of total population

[5] Industry index is defined as proportion of non-agriculture GDP of total GDP

This survey is based on randomly selected sample method and included respondents from age16 to 69. This survey collects individual information primarily about the previous year. I will focus on 2011 and 2012 minimum wage impact, so I use the data from 2012 to 2013, which are the latest data available.

Variables

Employment rate: the total number of respondent who have a job divided by the population

Gender: I set this variable as dummy variable, and one for male workers, female workers as the reference group

Age: 16-60 years old.

Education: less than middle school, middle school, at least some high school, high school graduate, at least some college education and college graduate.

Marital status: dummy variable, 1 for married

Health status: dummy variable, 1 for healthy

Hukou status: I set this variable as dummy variable, it equals to one if respondent holding urban hukou status, respondent who holding rural hukou status as the reference group

Table 1.4: Sample Means, Individuals Age 16-59, by Minimum Wage Increase through 2011-2012 in China

	Control Group	Treatment Group by Minimum Wage Increase			
		All	< 15%	15% - 25%	>25%
Age	36.5	36.9	36.2	37.0	37.5
Age 16-19	0.124	0.120	0.124	0.121	0.115
Male	0.508	0.511	0.516	0.511	0.506
Less than HS education	0.571	0.587	0.595	0.592	0.574
College graduate	0.151	0.156	0.144	0.165	0.159
Employment rate	0.732	0.741	0.748	0.742	0.734
Number of Observations	6,532	18,579	7,912	7,078	3,590

Source: CGSS 2012 and 2013

Sample means for 2011 are shown in Table 1.4, for individuals who are age 16-59, separately for the control and treatment group. In treatment group, I consider four groups: for all people, for minimum wage increase from 0 to 15%, 15% to 25% and more than 25%. The first column in Table 4 shows the summary statistics of respondents in the 7 provinces in which minimum wage did not increase in 2011-2012, while others four columns show summary statistics for all provinces in which minimum wage did increase and in just those provinces with minimum wage increase less than 15%, from 15% to 25% and above 25% respectively. The characteristics of workers in provinces with no minimum wage increase (column 1) and those in provinces with minimum wage increase (column 2, 3, 4 and 5) are quite similar on most measures. Average age and gender are substantially identical. Educational attainment and employment rate differ slightly: for people in the treatment group provinces (column 2), the educational attainment is higher and the difference is 1.6

percentage point for less than high school and 0.5 for college graduates. The difference across sub-groups among treatment group (column 2, 3, 4 and 5) is somewhat higher. Workers in column 3 (minimum wage increase rate <15%) have more with less high school education and less college graduate. The education difference is around 2 percentage points in column 3, 4 and 5 within the treatment group. The employment rate in treatment group provinces is around 1 percentage point higher than in control group with no minimum wage increase. Among treatment sub-groups, workers in column 5 have the lowest employment, and employment difference is around 1.5 percentage point within treatment group.

In Table 1.5, I examine whether the two proposed treatment groups and the within-state control group are appropriately to be affected and unaffected by minimum wage increase. Recall that I choose teens (age 16-19) without college education and adults (age 20-59) without high school education as at-risk groups as likely affected group by minimum wage increase and male adults (age 30-59) with at least some college education as the likely unaffected group. I explore whether the provincial minimum wage increases have any effect on workers' wages in the proposed groups, in that how minimum wage changes affect wage is a necessary precondition for employment effects.

Table 1.5: Wage Distribution for Selected Low-Wage Monthly Wage Workers, 2011 and 2012 in China

	Teens, 16-19, Not in College		Adults, 20-59, < HS Education	
	2011	2012	2011	2012
Treatment Group				
wage < 2011 MW	0.192	0.097	0.118	0.072
wage = 2011 MW	0.099	0.051	0.142	0.093
2011MW < w < 2012 MW	0.212	0.138	0.172	0.084
wage = 2012 MW	0.093	0.129	0.085	0.131
wage > 2012 MW	0.404	0.585	0.483	0.620
Average Monthly Wage (RMB)	1575.3	1618.4	1682.6	1738.2
Sample Size	1,067	1,019	2,216	2,158
Control Group				
wage < 2011 MW	0.187	0.142	0.105	0.078
wage = 2011 MW	0.119	0.104	0.153	0.137
wage > 2011 MW	0.694	0.754	0.742	0.785
Average Monthly Wage (RMB)	1603.1	1683.4	1703.5	1776.4
Sample Size	357	345	785	768

Source: Author's calculation from 2012 and 2013 CGSS data files.

In Table 1.5, treatment group is in the top panel and control group is in the lower panel. In the top panel, workers from the two proposed treatment groups were directly influenced by the minimum wage increase during 2011 and 2012. For teen workers (not in college) in column 1, about 60% of the teens had 2011 wages less than or equal to the 2012 minimum wage. For adult (age 20-59 without high school education) workers, the corresponding percentage is 51.7%. Therefore, a large number of less-educated people (teens and adults) earned a wage less than or equal to the minimum wage standards. If the wage distribution is affected by minimum wage increase, larger wage shifts in the treatment than in the control as I expect.

Table 1.5 shows that for teen workers, the proportion of wages were less than or equal to the old minimum both declined by half from 2011 to 2012. The proportion of wages were between the old and new minimum fell by 35%, from 21.2% to 13.8%. The proportion of wage were more than 2012 minimum standard increased around 45%. For adults who have no high school education, minimum wage increasing impact has the same pattern, but is smaller in absolute value. The proportion of wage were less than or equal to the 2011 minimum wage standard declined between 26% and 16.5% and the proportion of wages were between the two years minimum wages decreased by more than 50%. The proportion of wages were the new minimum wage nearly doubled and the proportion of wages were more than the 2012 minimum wage increased about 25 percent.

The lower panel in Table 1.5 shows the wage distribution changes in the control group. It includes the proportion of wages were less than, equal to and greater than the minimum wage standards in 2011 and 2012. It presents the comparison of the changes of the wage distribution in both treatment and control group, which indicate how minimum wage policy affects low-wage workers. In 2011, 30.6% of teen workers in the control groups earned less than or equal to the minimum in 2011, which is basically the same proportion as that in treatment group (29.1%). One year later, in 2012, 24.6% of teen workers were still wages were less than or equal to the 2011 minimum wage, compared to 14.8% of teens in treatment group. The proportion earning more than minimum wage increases from 69.4% to 75.4%, and the corresponding increase to wages above 2011 minimum in treatment group is from 70.9% to 85.2%. For the 20-59 adults without high school education workers, 25.8% of them earned less than or equal to 2011 minimum, and this rate drops to 21.5% in

2012. In the same time period, this rate of people in the treatment group decreased from 26% to 16.5%. I find that the wage distribution changes in the control group are similar to that in the treatment group, but smaller in magnitude.

Finally, I investigate the wage distribution for the selected unaffected group – adult male workers whose age 30-59 and have some college. In the provinces where the minimum wage increased, 1.8% earned less than the 2011 minimum wage in 2011, 0.3% earned exactly the minimum, 0.9% between the 2011 and the 2012 minimum wage, and 0.7% wages were equal to the 2012 minimum wage. The total equal to or below the 2012 minimum wage is less than 4%, which confirms that they were eventually unaffected group and they are a reliable control group.

From Tables 1.4 and 1.5, I can conclude that the proposed treatment and control groups are appropriately constructed; minimum wage increasing has influenced the wage distribution of young workers, and the changes were relatively more in the treatment group than that in the control group.

1.6 Empirical Results

In this section, I investigate how minimum wage increase affect employment in China during 2011-2012 by using Difference-in-difference (DID) and difference-in-difference-in-difference (DIDID) technique. I also analyze the results separately with three regions (eastern, central and western); and three ranges of minimum wage increase (0-15%, 15%-25% and 25% above). Besides, I also estimate the employment effect by regressions including multivariate controls for demographic characteristics and provincial fixed effects. Finally, the synthetic control method is employed to analyze the employment effect of the minimum wage increase.

1.6.1 DID and DIDID Analyses

During 2011-2012, twenty one provinces increased minimum wages, and at the same time seven provinces did not. Seven provinces are categorized as the control group, while the other provinces are categorized as the treatment group.

I present the results of the employment effects in Table 1.6. In the up two panels present employment rates for selected at-risk and unaffected workers in provinces with minimum wage increase and the group provinces where minimum wage did not increase. The lower panel lists the between and within DID and DIDID estimates. The t statistics are also included.

The employment rate of teens increased by 1.07 percentage points during 2011 and 2012 in the treatment group provinces and by 1.23 percentage points in the control group provinces. The between-province DID is -0.16 percentage points, about a 0.3% decrease in employment. The t value is 0.05, thus the effect is insignificant. The increase of employment in two groups are close, which reflects that various potential factors were similar across the two groups, including the continuing recovery from global recession and multiple economic stimulus programs announced by the Chinese central government. For all adult workers age 20-59 (not in high school), the employment rate increased 1.14 percentage points in the treatment group provinces and 1.41 percentage points in the control group provinces. The between-province DID is -0.27 percentage points, and the t value is 0.12. For teens and less-educated adult workers, I find very small adverse employment effects in both groups during the same time period, but the effects are not statistically significant. The baseline employment of both teens and less-educated adults is less in the provinces that minimum wage did not increase than in the provinces that minimum wage increased.

Table 1.6: Effects of Minimum Wage Increases on Employment of at-risk Groups

	Age16-19 (not in College)	Age 20-59 (not HS education)	Male Age 30-59 (at least some College)
Treatment Group			
2011			
Employment Rate	0.4586	0.6492	0.8848
Standard Deviation	0.0107	0.0078	0.0081
No. of Observations	2,168	3,759	1,549
2012			
Employment Rate	0.4693	0.6606	0.8922
Standard Deviation	0.0108	0.0078	0.0079
No. of Observations	2,129	3,698	1,532
Difference	0.0107	0.0114	0.0074
t-statistic	0.70	1.04	0.65
Control Group			
2011			
Employment Rate	0.4323	0.6313	0.8826
Standard Deviation	0.0179	0.0135	0.0135
No. of Observations	767	1,276	566
2012			
Employment Rate	0.4446	0.6454	0.8874
Standard Deviation	0.0181	0.0137	0.0135
No. of observations	755	1,218	552
Difference	0.0123	0.0141	0.0048
t-statistic	0.48	0.73	0.25
DID_B (T-C)	-0.0016	-0.0027	0.0026
t-statistic	0.05	0.12	0.12
DID_W (T-C)	0.0033	0.0040	
t-statistic	0.17	0.25	
DIDID	-0.0042	-0.0053	
t-statistic	0.11	0.17	

Source: CGSS

Within-province estimates (DID_W) are also shown in the lower panel in Table 1.6. I estimate the employment rate for teens with no college education and for adults with no high school education in treatment group provinces with those for males with some college education within the same province. The employment rate of the educated male workers increased by 0.74 percentage points (0.84% increase), so the within-provinces DID estimate for teens is 0.33 percentage points and statistically insignificant with t value 0.17. For the less-educated adults, the within-province DID estimate is 0.4 percentage points, while the difference is not statistically significant. I find that the larger within-provinces estimates means that employment of less-skilled workers is typically more cyclically sensitive.

In the last row of Table 1.6 I list the DIDID result. I find that there could be bias exists between and within DID estimates, in that if economic developments are not similar between treatment and control provinces, and if relative labor demands were not same in treatment provinces coincident with the change. The DIDID estimates deal with the potential biases to estimate the between-province DID for the groups which are likely to be affected and using DID_W from the provinces that minimum wage did not increase to estimate the within-province DID.

The DIDID for teens with no college education is -0.0016-0.0026=-0.0042, and the t value is 0.11 which is statistically insignificant[6]. The DIDID estimate for less-educated adults is -0.0053 and also statistically insignificant. Therefore, I find a slightly negative employment effect for at-risk groups, while the effect is statistically insignificant.

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[6] This can also be computed as 0.0033-(0.0048-0.0123) =-0.0042

Because of the wide range of changes in minimum wage shown in Table 1.2 and unbalanced economic development in different regions, I will examine DID separately by three different regions (Eastern, Central and Western China) and accordingly three ranges of minimum wage increase (less than 15%, 15%-25% and above 25%). Table 1.7 lists the summary results of different regions and Table 1.8 lists the summary results of three increase ranges. All the results are in Appendix A.

Table 1.7: Effects of Minimum Wage Increases on Employment Rate of At-Risk Group by Region in China, 2011-2012

	Age 16-19 (not in College)	Age 20-59 (< HS education)	Male Age 30-59 (at least some College)
Eastern Region			
Treatment Group			
Change in Employment	-0.0093	0.0017	0.0113
t-statistic	0.42	0.11	0.66
Control Group			
Change in Employment	0.0083	0.0121	0.0029
t-statistic	0.22	0.44	0.11
DID_B (T-C)	-0.0176	-0.0104	0.0084
t-statistic	0.4	0.33	0.27
DID_W (T-C)	-0.0206	-0.0096	
t-statistic	0.74	0.41	
DIDID	-0.026	-0.0188	
t-statistic	0.48	0.42	
Central Region			
Treatment Group			
Change in Employment	0.0178	0.0162	0.0041
t-statistic	0.57	0.72	0.18
Control Group			
Change in Employment	0.0157	0.0151	0.0087
t-statistic	0.37	0.51	0.29
DID_B (T-C)	0.0021	0.0011	-0.0046
t-statistic	0.04	0.03	0.12
DID_W (T-C)	0.0137	0.0121	
t-statistic	0.36	0.38	

DIDID	0.0067	0.0057	
t-statistic	0.1	0.11	
Western Region			
Treatment Group			
Change in Employment	0.0262	0.0181	0.007
t-statistic	0.92	0.89	0.18
Control Group			
Change in Employment	0.0142	0.0145	0.0048
t-statistic	0.24	0.24	0.09
DID_B (T-C)	0.012	0.0036	0.0022
t-statistic	0.18	0.06	0.04
DID_W (T-C)	0.0192	0.0111	
t-statistic	0.55	0.39	
DIDID	0.0098	0.0014	
t-statistic	0.11	0.02	

Source: CGSS

1.6.1.1 Eastern Region

The Eastern region (eleven provinces), located in the sea coast, where is the most prosperous region of China. The Eastern region has 38%[7] of the total population but accounts for 58% of total GDP in 2015[8].

During 2011-2012, in the Eastern region eight provinces increased their minimum wage while three provinces did not[9]. The highest increase occurred in Hainan province (26.5 percentage point) and the lowest was in Beijing (8.6 percentage point), and the average minimum wage increases in these provinces was 14.8

[7] The Sixth National Population Census of the People's Republic of China

[8] China Statistic Yearbook 2015

[9] See Table 1.2. Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Fujian, Shandong, Hainan increased minimum wage, while Liaoning, Zhejiang and Guangdong did not.

percentage points. The eight provinces serve as the treatment group, while the other provinces serve as in the control group.

In Table 1.7, the employment rate of teens with no college education declined by 0.93 percentage points during 2011 and 2012 in the treatment group provinces and increased by 0.83 percentage points in the control group provinces. The between-province DID is -1.76 percentage points, about a 3.5% decrease in employment rate. The t value is 0.40, thus the employment effect is insignificant. For adults with no high school education, I find the employment increased by 0.17 percentage points in the treatment group provinces and increased by 1.21 percentage points in the control group provinces. The between-province DID is -1.04 percentage points with t value of 0.33.

The baseline employment rate of teens and less-educated adults and even male adults with some college education both in treatment and control group are higher in Eastern China. This is because that majority of enterprises and labor intensive factories are located in the Eastern provinces of China, especially in the coastal region like Guangdong, Jiangsu, Zhejiang and Shanghai. During 2011-2012, employment of teens declined in provinces where the minimum wage increased, which is contradictory to that in Table 1.6. And the increases of less-educated adults employment in provinces where minimum increased is much lower than that in Table 1.6, which is about one seventh (0.0017 vs 0.0114). The between-province estimates are both negative, which implies that teens and young workers face more adverse employment effect of minimum wage policy in Eastern China.

Within-province estimates (DIDW) are also shown in Table 1.7. The employment rate for the 30-59 years old male workers increased by 1.13 percentage points in these provinces, so the within-provinces DID estimate for teen is -2.06 percentage points and statistically insignificant with t value 0.74. For the less-educated adults, the within-province DID estimate is -0.96 percentage points, the employment effect is statistically insignificant.

The DIDID estimate for teens is -0.0176-0.0084 = -0.026, and the t value is 0.48 which is statistically insignificant[10]. The DIDID estimate for less-educated adults is -0.0188 and also statistically insignificant. Therefore, I find a slightly negative employment effect for both teens and less-educated adults in Eastern China, while the employment effect is not statistically significant. I find that the result is consistent with Wang and Gunderson's (2011) research.

1.6.1.2 Central Region

The Central region is less developed than Eastern China and consists of eight provinces in this study. During 2011-2012, in the central region five provinces increased their minimum wage while three provinces did not[11]. The highest increase occurred in Heilongjiang province (31.8 percentage points) and the lowest was in Jilin (11.5 percentage point), and the average minimum wage increases in these provinces was 18.52 percentage point. The magnitude of minimum wage increase was higher in the Central region than that in Eastern China, while the minimum wage level was low in the Central region. The five provinces serve as the treatment group, while the other three provinces serve as in the control group.

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[10] This can also be computed as -0.0206-(0.0029-0.0083) =-0.026

[11] See Table 1.2. Heilongjiang, Jilin, Shanxi, Jiangxi and Hunan increased minimum wages, while Anhui, Henan and Hubei did not.

In Table 1.7, the employment of teens with no college education increased by 1.78 percentage points during 2011 and 2012 in the treatment group provinces and increased by 1.57 percentage points in the control group provinces. The between-province DID is 0.21 percentage points, about a 0.5% increase in employment rate. The t value is 0.04, thus the effect is insignificant. For the less-educated adults, the employment rate increased by 1.62 percentage points in the treatment group provinces and increased by 1.51 percentage points in the control group provinces. The between-province DID is 0.11 percentage points and the t value is 0.03.

Within-province (DIDW) are also presented in Table 1.7. The employment for the educated male workers increased by 0.41 percentage point, so the within-provinces DID estimate for teens is 1.37 percentage points and statistically insignificant with t value 0.36. For the less-educated adults, the within-province DID estimate is 1.21 percentage points, and the effect is also insignificant.

The DIDID estimate for teens is 0.0021-(-0.0046) = 0.0067, and the t value is 0.10 which is statistically insignificant[12]. The DIDID estimate for less-educated adults is 0.0057 and also statistically insignificant. Therefore, I find that for teens and less-educated adults the employment effect are both positive in Central China, which is completely opposite with the previous results in Eastern China, while the employment effects are still statistically insignificant.

[12] This can also be computed as 0.0137-(0.0157-0.0087) =0.0067

1.6.1.3 Western Region

The Western region (nine provinces[13]) is considerably the least developed with the slowest growth. This region covers nearly half the territory of the whole country and most of the minority people reside in this region. During 2011-2012, in the Western region eight provinces increased their minimum wage while only one province did not[14]. The highest increase occurred in Xinjiang province (39.5 percentage points) and the lowest was in Inner Mongolia (14.3 percentage points), and the average minimum wage increases in these provinces was 22.6 percentage points. In Western China, minimum wage increased fasted among three regions. Treatment group include the eight provinces, while Guizhou serves as in the control group.

In Table 1.7, the employment of teens with no college education increased by 2.62 percentage points during 2011 and 2012 in the treatment group provinces and increased by 1.42 percentage points in the control group provinces. The between-province DID is 1.2 percentage points, about a 2.8% increase in employment rate. The t value is 0.18, thus the effect is insignificant. For the adults with no high school education, the employment increased by 1.81 percentage points in the treatment group provinces and increased by 1.45 percentage points in the control group provinces. The between-province DID is 0.36 percentage points, and the t value is 0.06.

Within-province (DIDW) are also presented in Table 1.7. The employment for educated male workers increased by 0.7 percentage points, so the within-provinces

[13] Tibet, Ningxia and Qinghai are not included because that CGSS does not collect data from these three provinces

[14] See Table 1.2. Sichuan, Chongqing, Yunnan, Shannxi, Gansu, Xinjiang, Guangxi and Inner Mongolia increased minimum wages, while Guizhou did not.

DID for teens is 1.92 percentage points and statistically insignificant with t value 0.55. For the less-educated adults, the within-province DID estimate is 1.11 percentage points, and the effect is insignificant.

The DIDID estimate for teens is 0.012-0.0022= 0.0098, and the t value is 0.11 which is statistically insignificant[15]. The DIDID estimate for less-educated adults is 0.0014 and also statistically insignificant. Therefore, I also find that for teens and less-educated adults the employment effect is positive in Western China, especially for teen workers, while the employment effects are still statistically insignificant.

I can conclude that minimum wage increase during 2011-2012 in China has had a small and statistically insignificant adverse employment effect both for teens with no college education and adults who have no high school education. In terms of different regions, the employment effects are complex and diversified. For more the developed region (Eastern China), minimum wage increases has adverse effect and decreased the job opportunities for both teens and less-educated adults, but this effect is statistically insignificant. In Central and Western China, minimum wage increase positively promote job opportunities for teens and less-educated adults, which are eventually opposite of the results in Eastern region. Theoretically, the results are convincing because Eastern China is the most developed region and has plenty of factories and enterprises, therefore the labor market is relatively competitive. In this kind of market, minimum wage increases impact employment negatively, as mentioned in the previous chapter. In less developed regions like Western and Central China, the market economy is less well developed and monopsony power is still

[15] This can also be computed as 0.0192-(0.0142-0.0048) =0.0098

existing. Accordingly, a minimum wage increase would provide more job opportunities for workers.

In order to have a full picture of the minimum wage impact, I estimate how different ranges of minimum wage increase affect employment. I classify the minimum wage increase during 2011-2012 into three ranges: 0-15%, 15%-25% and 25% above. I use the same method (DID & DIDID) to investigate the potential employment effect for the same selected group: teens without college education, less-educated adults and male adults with at least some college education. The results are in Table 1.8. The control group is the same for each treatment group, so I put it in the first row and didn't repeat it.

Table 1.8: Employment Effects of Minimum Wage Increases for At-Risk Group by Size of Minimum Wage Increase in China, 2011-2012

	Age 16-19 (not in College)	Age 20-59 (< HS education)	Male Age 30-59 (at least some College)
No Change in MW			
Change in Employment	0.0123	0.0141	0.0048
t-statistic	0.48	0.73	0.25
Increase in MW < 15%			
Change in Employment	0.0188	0.0165	0.0062
t-statistic	0.8	0.99	0.35
DID_B (T-C)	0.0065	0.0024	0.0014
t-statistic	0.19	0.09	0.05
DID_W (T-C)	0.0126	0.0103	
t-statistic	0.43	0.43	
DIDID	0.0051	0.001	
t-statistic	0.12	0.03	
Increase in MW 15-25%			
Change in Employment	0.0097	0.0128	0.0058
t-statistic	0.4	0.7	0.31
DID_B (T-C)	-0.0026	-0.0013	0.001
t-statistic	0.07	0.05	0.04

DID_W (T-C)	0.0039	0.007	
t-statistic	0.13	0.27	
DIDID	-0.0036	-0.0023	
t-statistic	0.08	0.06	
Increase in MW > 25%			
Change in Employment	0.0055	-0.0029	0.0144
t-statistic	0.15	0.12	0.58
DID_B (T-C)	-0.0068	-0.017	0.0096
t-statistic	0.15	0.54	0.31
DID_W (T-C)	-0.0089	-0.0173	
t-statistic	0.2	0.5	
DIDID	-0.0164	-0.0266	
t-statistic	0.3	0.6	

Source: CGSS

1.6.1.4 Increase in MW <15%

During 2011-2012, nine provinces increased their minimum wage by 0 to 15%, Beijing, Tianjin, Shanghai, Fujian and Shandong in eastern China, Jilin, Shanxi and Hunan in the Central, and Inner Mongolia in the Western. Treatment group includes the nine provinces, while seven other provinces serve as the control group.

In Table 8, the employment of teens with no college education by 1.88 percentage points during 2011 and 2012 in the treatment group provinces and increased by 1.23 percentage points in the control group provinces. The between-province DID is 0.65 percentage points, about a 1.4% increase in employment rate. The t value is 0.19, thus the effect is insignificant. For the adults with no high school education, the employment increased by 1.65 percentage points in the treatment group provinces and increased by 1.41 percentage points in the control group provinces. The between-province DID is 0.24 percentage points, and the t value is 0.09.

Within-province (DID_W) are also presented in Table 1.8. The employment for educated male workers increased by 0.62 percentage points, so the within-provinces

DID estimate for teens is 1.26 percentage points and statistically insignificant with t value 0.43. For the less-educated adults, the within-province DID estimate is 1.03 percentage points, while the effect is insignificant.

The DIDID estimate for teens is 0.0065 – 0.0014 = 0.0051, and the t value is 0.12 which is statistically insignificant[16]. The DIDID estimate for less-educated adults is 0.001 and also statistically insignificant. Therefore, I find that the employment effect for teens and less-educated adults are both slightly positive if minimum wage increased from 0 to 15%. That means, if minimum wage increases less than 15%, employment of teens and less-educated adults will both increase moderately.

1.6.1.5 Increase in MW 15-25%

During 2011-2012, there are eight provinces that increased their minimum wage range from 15 to 25%, Hebei and Jiangsu in eastern China, Jiangxi in central China, and Sichuan, Chongqing, Yunnan, Shannxi and Guangxi in western China. These eight provinces serve as the treatment group, while seven other provinces serve as the control group.

In Table 1.8, the employment of teens with no college increased by 0.97 percentage points during 2011 and 2012 in the treatment group provinces and increased by 1.23 percentage points in the control group provinces. The between-province DID is -0.26 percentage points, about a 0.6% decrease in employment rate. The t value is 0.07, thus the effect is insignificant. For the adults with no high school education, the employment increased by 1.28 percentage points in the treatment group

[16] This can also be computed as 0.0126-(0.0123-0.0048) =0.0051

provinces and increased by 1.41 percentage points in the control group provinces. The between-province DID is -0.13 percentage points, and the t value is 0.05.

Within-province (DID_W) are also presented in the lower panel in Table 1.8. The employment for educated male workers increased by 0.58 percentage points, so the within-provinces DID estimate for teens is 0.39 percentage points and statistically insignificant with t value 0.13. For the less-educated adults, the within-province DID estimate is 0.70 percentage points, while the effect is insignificant.

The DIDID estimate for teens is -0.0026-0.0010 = -0.0036, and the t value is 0.08 which is statistically insignificant[17]. The DIDID estimate for less-educated adults is -0.0023 and also statistically insignificant. Therefore, I find that the employment effect for teens and less-educated adults are both slightly negative in provinces where minimum wage increased from 15 to 25%. That means, there is negative employment effect if minimum wage increases from 15% to 25%, which is contrary to what happens if the minimum wage increases less than 15%.

1.6.1.6 Increase in MW >25%

During 2011-2012, there are four provinces that increased their minimum wage by over 25%, Hainan in eastern China, Heilongjiang in the Central, Gansu and Xinjiang in the Western. Treatment group includes the four provinces, while seven other provinces serve as in the control group.

In Table 1.8, the employment of teens with no college education increased by 0.55 percentage points during 2011 and 2012 in the treatment group provinces and

[17] This can also be computed as 0.0039-(0.0123-0.0048) =-0.0036

increased by 1.23 percentage points in the control group provinces. The between-province DID is -0.68 percentage points, about a 1.5% decrease in employment rate. The t value is 0.15, thus the effect is insignificant. For the adults with no high school education, the employment decreased by -0.29 percentage points in the treatment group provinces while it increased by 1.41 percentage points in the control group provinces. The between-province DID is -1.70 percentage points, and the t value is 0.54.

Within-province (DID_W) are also presented in Table 1.8. The employment for the educated male workers increased by 1.44 percentage point, so the within-provinces DID estimate for teen is -0.89 percentage points and statistically insignificant with t value 0.20. For the less-educated adults, the within-province DID estimate is -1.73 percentage points, while the effect is insignificant.

The DIDID estimate for teens is -0.0068-0.0096 = -0.0164, and the t value is 0.30 which is statistically insignificant[18]. The DIDID estimate for less-educated adults is -0.0266 and also statistically insignificant. Therefore, I find that the employment effects for teens and less-educated adults are even more negative than that in provinces where minimum wage increased above 15% and less than 25%.

According to the investigation of various ranges of minimum wage increase, I find that minimum wage does affect the employment of teens. If the minimum wage increases by less than 15%, teens' employment would increase; however, with the minimum wage increase even further, teens would be jeopardized and obtain fewer employment opportunities, however, this effect is not statistically significant. As for

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18 This can also be computed as -0.0089-(0.0123-0.0048) =-0.0164

less educated adults, I find the same pattern as with teens so that if the minimum wage increases by less than 15%, the employment of less-educated adults benefits less than that of teens, and is jeopardized even more as the minimum wage increases by more than 25%. In conclusion, a moderate minimum wage increase encourages employers to provide more employment opportunities, but employers are reluctant to hire teens and less-educated workers with even higher minimum wage level.

1.6.2 Multivariate Analysis

I estimate regression-adjusted difference-in-difference models to improve the estimation of the employment effect of minimum wage increases. Three models are included in this part: model 1 is the basic regression with DID variables; model 2 add a set of individual demographic variables; model 3 further add location fixed effects. Tables 1.9-1.11 present the regression results for the at-risk group of teens (age 16-19) without college education, and Tables 1.12-1.14 present the estimation results for another at-risk group less-educated adults.

Table 1.9 presents the regression results of how minimum wage increased affect the employment of teens without college education during 2011 and 2012 between treatment and control groups. I first regress a basic model without considering economic and individual demographic influence. Two dummy variable are included in this basic regression: group dummy variable and year dummy variable, and the interaction term year*group, which measures the employment effect, is our interest. The estimation results are presented in Column 1 of Table 1.9, the estimate of interaction is -0.0016 and statistically insignificant, which is identical to the results presented in Table 1.6.

The estimation results of regression with individual control variables (gender, marital status, health condition, hukou status) are shown in Column 2. The coefficient of interaction term is -0.0012, the magnitude value of this estimate is smaller and still negative. I find that male teens obtain less employment opportunities than female teens, and employer are less likely to hire married teens. More healthy people are more likely to be employed, which is reasonable. The labor-intensive factories in China hire more migrant workers who are usually have rural hukou status, thus people who have rural hukou status have more opportunities to be employed.

In the third model I add province fixed effects because the economic development varies dramatically in each region of China. The estimates results in the Column 3 are barely changed and indicates that employment effect is not related to location.

Table 1.9: Regression Estimates of Teens Without College Education Group 2011-2012 Between Group DID (standard errors in parentheses)

Independent variables	(Dependent variable: employment)		
	1	2	3
group	0.0263** (0.0129)	0.0191 (0.0422)	0.0165 (0.0427)
year	0.0123 (0.0254)	0.0173 (0.0246)	0.0124 (0.0643)
year*group	-0.0016 (0.0296)	-0.0012 (0.0742)	0.0011 (0.0539)
male		-0.0134 (0.0867)	-0.0183 (0.0760)
married		-0.0176 (0.0845)	-0.0276 (0.0536)
healthy		0.0241 (0.0534)	0.0185 (0.0641)
urban hukou		-0.0256 (0.0223)	-0.0167 (0.0955)
constant	0.4323 (0.4399)	0.3767 (0.2505)	0.3819 (0.2672)
N	5,819	5,776	5,776
R^2	0.05	0.09	0.10

Notes: 1: Column 1 is the basic DID setup; Column 2 adds a set of demographic control variables; Column 3 adds province fixed effects. 2: "group" stands for the group dummy variable, it equals 1 if teens without college education in the treatment group, otherwise, it equals 0; "year" stands for the year dummy variable, it equals 1 if the year is 2012, otherwise, it equals 0, "year*group" is the DID estimator which gives the net effect of minimum wage increase. 3: * = statistically significant at 10% level, ** = statistically significant at 5% level.

Table 1.10 reports the within comparison estimates results of teens without college education during 2011 and 2012 in the treatment group, comparing them to educated male adults. The estimation results of the basic DID setup, regression with individual covariates and regression with region fixed effects are in Columns 1, 2 and 3 respectively. The estimate of the interaction term (year*teens) barely changes, which are positive and statistically insignificant. Married, unhealthy and urban workers are also less likely to be employed.

Table 1.10: Regression Estimates of Teens Without College Education Group 2011-2012 Within Group DID (standard errors in parentheses)

Independent variables	(Dependent variable: employment)		
	1	2	3
teens	-0.4262**	-0.3821**	-0.3483*
	(0.2193)	(0.1542)	(0.1872)
year	0.0074	0.0068	0.0065
	(0.0113)	(0.0156)	(0.0183)
year*teens	0.0033	0.0041	0.0043
	(0.0190)	(0.0232)	(0.0194)
married		-0.0219	-0.0232
		(0.2384)	(0.5236)
healthy		0.0283	0.0301
		(0.1524)	(0.1326)
urban hukou		-0.0175	-0.0159
		(0.0229)	(0.0195)
constant	0.8848	0.7845	0.7654
	(0.9327)	(0.6708)	(0.6812)
N	7,378	7,261	7,261
R^2	0.06	0.08	0.11

Notes: 1: Column 1 is the basic DID setup; Column 2 adds a set of demographic control variables; Column 3 adds province fixed effects. 2: "teens" stands for the group dummy variable, it equals 1 if the respondents are teens without college education in the treatment group, otherwise, it stands for male workers with at least some college education and equals 0; "year" stands for the year dummy variable, it equals 1 if the year is 2012, otherwise, it equals 0, "year*teens" is the DID estimator which gives the net effect of minimum wage increase. 3: * = statistically significant at 10% level, ** = statistically significant at 5% level.

Table 1.11 lists the DIDID estimate results of teens without college education. The estimate results of basic DID setup, regression with individual covariates and regression with province fixed effects are in Columns 1, 2 and 3 respectively. The parameter of our interest is on the year*group*teens, which is DIDID estimates. The DIDID estimate result is negative and small, while insignificant in all three scenarios. From the results, I can conclude that minimum wage increases during 2011 to 2012 has a negative and statistically insignificant effect on teens (age 16-19) with no college education.

Table 1.11: Regression Estimates of Teens Without College Education Group 2011-2012 DIDID (standard errors in parentheses)

Independent variables	(Dependent variable: employment)		
	1	2	3
group	0.0022	0.0018	0.0031
	(0.0145)	(0.0122)	(0.0154)
year	0.0048	-0.0078	0.0075
	(0.0191)	(0.0162)	(0.0168)
teens	-0.4503*	-0.4108	-0.3789
	(0.2722)	(0.3573)	(0.2987)
year*group	-0.0016	0.0047	0.0059
	(0.0296)	(0.0389)	(0.0428)
year*teens	0.0033	0.0039	0.0041
	(0.0190)	(0.0098)	(0.0098)
group*teens	0.0199	0.0131	0.0189
	(0.0295)	(0.2386)	(0.1248)
year*group*teens	-0.0042	-0.0014	-0.0075
	(0.0370)	(0.0429)	(0.0760)
married		-0.0463	-0.0411
		(0.2384)	(0.1956)
healthy		0.0367	0.0386
		(0.1154)	(0.1116)
urban hukou		-0.0058	-0.0062
		(0.2967)	(0.1095)
constant	0.6747	0.6087	0.7037
	(0.5076)	(0.6587)	(0.7631)
N	9,956	9,768	9,768
R^2	0.07	0.11	0.12

Notes: 1: Column 1 is the basic DIDID setup; Column 2 adds a set of demographic control variables; Column 3 adds province fixed effects. 2: “year” stands for the year dummy variable, it equals 1 if the year is 2012, otherwise, it equals 0, “teens” stands for the group dummy variable, it equals 1 if the respondents are teens without college education in the treatment group, otherwise, it stands for male workers with at least some college education and equals 0; “group” stands for the group dummy variable, it equals 1 if teens without college education in the treatment group, otherwise, it equals 0; “year*group*teens” is the DIDID estimator which gives the net effect of minimum wage increase. 3: * = statistically significant at 10% level, ** = statistically significant at 5% level.

The results for the sample of adults with low education are list in Table 1.12-1.14. The estimate results are similar to the results of teens sample. For adults, the estimates are negative and insignificant. The within-province estimates are small, positive, and statistically insignificant. The most reliable DIDID results also show that minimum wage increased during 2011 to 2012 has no effect on employment of less-educated adults.

Table 1.12: Regression Estimates of Adults With no High School Education Group 2011-2012 Between Group DID (standard errors in parentheses)

Independent variables	(Dependent variable: employment)		
	1	2	3
group	0.0179 (0.0795)	0.0165 (0.0422)	0.0149 (0.0427)
year	0.0141 (0.0192)	0.0117 (0.0136)	0.0102 (0.1268)
year*group	-0.0027 (0.0222)	-0.0014 (0.0422)	-0.0012 (0.0329)
male		-0.0134 (0.1087)	-0.0183 (0.1070)
married		-0.0276 (0.0984)	-0.0147 (0.0542)
healthy		0.0217 (0.5434)	0.0185 (0.1436)
urban hukou		-0.0063	-0.0071

		(0.0232)	(0.0129)
constant	0.6313	0.5567	0.5281
	(0.5489)	(0.4905)	(0.6372)
N	9,951	9,876	9,876
R^2	0.06	0.08	0.09

Notes: 1: Column 1 is the basic DID setup; Column 2 adds a set of demographic control variables; Column 3 adds province fixed effects. 2: “group” stands for the group dummy variable, it equals 1 if teens without college education in the treatment group, otherwise, it equals 0; “year” stands for the year dummy variable, it equals 1 if the year is 2012, otherwise, it equals 0, “year*group” is the DID estimator which gives the net effect of minimum wage increase. 3: * = statistically significant at 10% level, ** = statistically significant at 5% level.

Table 1.13: Regression Estimates of Adults With no High School Education Group 2011-2012 Within Group DID (standard errors in parentheses)

Independent variables	(Dependent variable: employment)		
	1	2	3
adults	-0.2356**	-0.2152	-0.1953*
	(0.1219)	(0.1542)	(0.1128)
year	0.0074	0.0068	0.0055
	(0.0113)	(0.0156)	(0.0168)
year*adults	0.0040	0.0081	0.0093
	(0.0158)	(0.0242)	(0.0194)
married		0.0249	0.0252
		(0.2384)	(0.3256)
healthy		0.0383	0.0401
		(0.0435)	(0.0551)
urban hukou		-0.0975	-0.0865
		(0.0822)	(0.0841)
constant	0.8532	0.7543	0.7843
	(0.7697)	(0.6908)	(0.7112)
N	10,538	10,176	10.176
R^2	0.07	0.10	0.11

Notes: 1: Column 1 is the basic DID setup; Column 2 adds a set of demographic control variables; Column 3 adds province fixed effects. 2: "adults" stands for the group dummy variable, it equals 1 if the respondents are adults (20-59) with no high school education in the treatment group, otherwise, it stands for male workers with at least some college education and equals 0; "year" stands for the year dummy variable, it equals 1 if the year is 2012, otherwise, it equals 0, "year*adults" is the DID estimator which gives the net effect of minimum wage increase. 3: * = statistically significant at 10% level, ** = statistically significant at 5% level.

Table 1.14: Regression Estimates of Adults With no High School Education Group 2011-2012 DIDID (standard errors in parentheses)

Independent variables	(Dependent variable: employment)		
	1	2	3
group	0.0022	0.0025	0.0034
	(0.0145)	(0.0142)	(0.0154)
year	0.0048	0.0178	0.1275
	(0.0191)	(0.1063)	(0.0684)
adults	-0.2513**	-0.1708	-0.1189
	(0.1012)	(0.1445)	(-0.1987)
year*group	-0.0027	0.0567	0.5497
	(0.0222)	(0.0389)	(0.1398)
year*adults	0.0040	0.3429	0.2389
	(0.0158)	(0.1798)	(0.9874)
group*adults	0.0104	0.0131	0.0119
	(0.0281)	(0.0246)	(0.0278)
year*group*adults	-0.0053	0.0045	0.0076
	(0.0314)	(0.0129)	(0.0760)
married		-0.0363	-0.0311
		(0.1284)	(0.1456)
healthy		0.0167	0.0286
		(0.0154)	(0.0163)
urban hukou		-0.0280	-0.0224
		(-0.0329)	(-0.0395)
constant	0.4743	0.5087	0.5037
	(0.3764)	(0.4587)	(0.5131)
N	14,150	13,753	13,753
R^2	0.10	0.12	0.13

Notes: 1: Column 1 is the basic DIDID setup; Column 2 adds a set of demographic control variables; Column 3 adds province fixed effects. 2: “year” stands for the year dummy variable, it equals 1 if the year is 2012, otherwise, it equals 0, “adults” stands for the group dummy variable, it equals 1 if the respondents are adults (20-59) with no high school education in the treatment group, otherwise, it stands for male workers with at least some college education and equals 0; “group” stands for the group dummy variable, it equals 1 if teens without college education in the treatment group, otherwise, it equals 0; “year*group*adults” is the DIDID estimator which gives the net effect of minimum wage increase. 3: * = statistically significant at 10% level, ** = statistically significant at 5% level.

1.6.3 Synthetic Control Method

Abadie (2003; 2010) pioneered an alternative approach - synthetic control method. Similar to a difference-in-difference design, synthetic controls exploits the difference in treatment group and control group across the event of interest. However, in contrast to a difference-in-differences design, synthetic controls does not give all control units the same weight in the comparison. Instead, it generates a weighted average unit which matches the treatment unit as closely as possible over the pre-treatment period. In this study, I firstly employ this method to fill the literature gap in Chinese minimum wage research.

Specifically, synthetic control method computes a time-invariant weighted average of available control group to construct a counterfactual unit for the treated group. To be a valid synthetic control unit, it should has as similar as possible pre-treatment characteristics compared to the treated unit. I employ factors which are likely employment changes predicators to generate an aggregated synthetic control group, including: GDP per capita[19], urbanization rate[20], industrialization index[21] and

[19] GDP capital is defined by annual provincial GDP divided by provincial population.

CPI[22]. I choose the time range from 2010 to 2013 because I want to analyze the trend before and after the minimum wage increased during 2011 and 2012. I estimate effects for teens (age 16-19) not in college and less-educated adults.

Teens (age 16-19) not in college

I follow Abadie (2003; 2010) and Galianni (2016) and use STATA software to obtain synthetic control method estimates for teens not in college. Figure 1.6 is a graphic result of the synthetic control method for employment of teens in China from 2010 to 2013. Before 2011, the treated and synthetic control units[23] follow the same pattern. From 2011 to 2012, when the minimum wage increased in some Chinese provinces but not in others, employment of teens in treated and synthetic control units both decreased. Employment in the treated unit decreased more than that in the synthetic control unit. Table 1.15 lists the predictor results. I find that all four predictors are almost the same in both treated and synthetic control group which means that synthetic control group closely matches the treatment group. The employment in both treated and synthetic control group declines. Employment

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20 Urbanization rate is defined by urban population divided by total population of each province.

21 Industry index is defined by non-agriculture GDP divided by total GDP of each province

22 All data are collected from National Bureau of Statistics of China

23 From the STATA program result, the weights for provinces in synthetic control groups as follows, 5.7% for Guangdong province, 33.6% for Hebei province, 55.7 for Heilongjiang provinces and 0 for rest other provinces.

decreases by 1.03% in the treated unit and decreases by 0.39% in the synthetic control unit. Employment decreased more in the group where minimum wage increased during 2011 and 2012. The results are consistent with previous regression estimates results of teens without college education. The result of RMSPE is 0.000357, further indicates that the result is reliable[24].

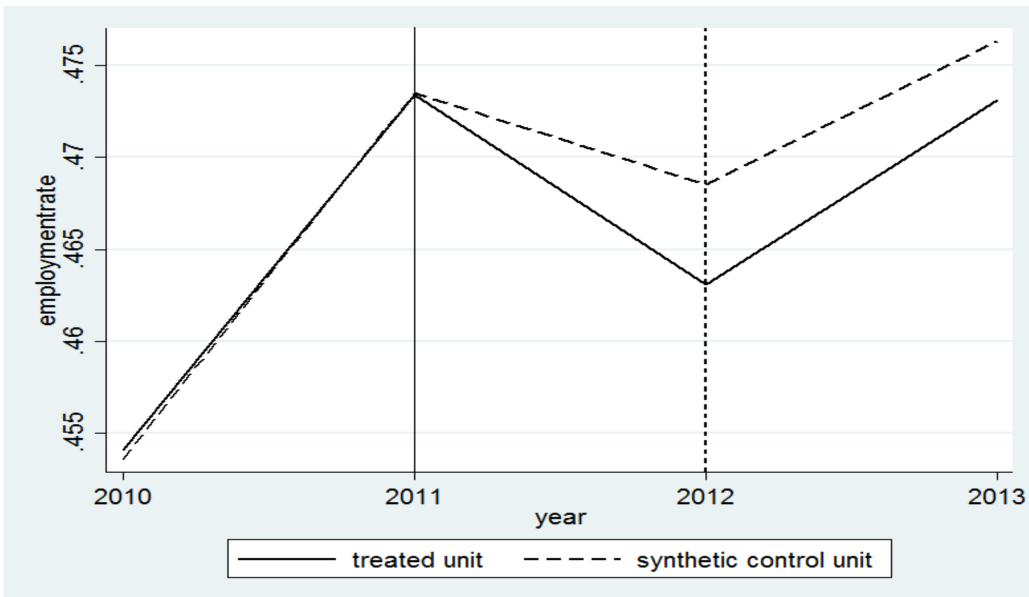

Figure 1.6: Graphic Result of the Synthetic Control Method for Employment of Teens in China 2010-2013

24 RMSPE (Root Mean Squared Prediction Error) shows the difference between the predicted values with the real values, which is the smaller the better.

Table 1.15: Predictor Results of Synthetic Control Method for Teens in China 2010-2013

Predictor	Treated	Synthetic
GDP per capital	3.5797	3.6908
Urbanization rate	0.5584	0.5526
Industry index	0.9168	0.9101
CPI	0.0345	0.0357
Employment rate(2011)	0.4734	0.4724
Employment rate(2012)	0.4631	0.4685

RMSPE	0.0003557

Adults (age 20-59) with no high school education

Figure 1.7 is graphic result of the synthetic control method for employment of adults (no HS education) in China from 2010 to 2013. Before 2011, the treated and synthetic control unit[25] almost follow the same pattern. From 2011 to 2012, when the minimum wage increased in some Chinese provinces but not in others, employment of adults in treated and synthetic control units both increased. Employment in treated unit increased more than that in the synthetic control unit. Table 1.16 lists the estimates for predictors. I find that all four predictors are almost same in both treated and synthetic control group which means that synthetic control group matches closely the treatment group. The employment in both treated and synthetic control groups increases, employment increases 1.9% in the treated unit and increases 1.65% in the synthetic control unit. Employment increased more in the group where the minimum wage

25 From the STATA program result, the weights for provinces in synthetic control groups as follows, 1.6% for Guangxi province, 10% for Guizhou province, 64% for Jiangxi province, 24.4% for Shanghai and 0 for rest other provinces.

increases during 2011 and 2012. The results are consistent with previous regression estimates for adults with no high school education when considering demographic control variables and province fixed effect. The result of RMSPE is 0.0001311, further indicates that the result is reliable.

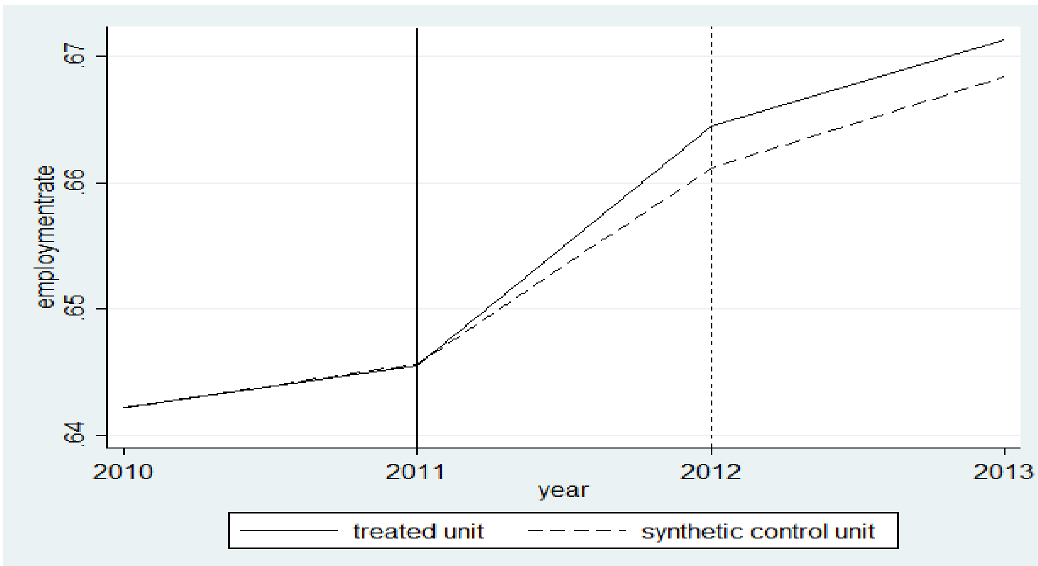

Figure 1.7: Graphic Result of the Synthetic Control Method for Employment of Adults (no HS education) in China 2010-2013

Table 1.16: Predictor Results of Synthetic Control Method for Adults in China 2010-2013

Predictor	Treated	Synthetic
GDP per capital	3.5797	3.7856
Urbanization rate	0.5584	0.5408
Industry index	0.9168	0.9131
CPI	0.0345	0.0346
Employment rate(2011)	0.6455	0.6456
Employment rate(2012)	0.6645	0.6621

RMSPE	0.0001311

1.7 Conclusion

In this essay, I analyze how a minimum wage increase impacted employment in China in 2011 and 2012 using data from China General Social Survey (CGSS). I contribute to the existing literature by examining how minimum wage increases impact workers in some provinces in 2011. This essay fills the gap to the existing literature in three aspects. First, I estimate the minimum wage increase during 2011 and 2012, which provides the latest evidence of the existing literature. Second, this is the first essay to estimate minimum wage policy impacts in China with difference-in-difference-in-difference (DIDID). Last, I first use Synthetic Control Method to estimate how minimum wage increase affected employment in China.

I compute both between-province and within-province DID estimates and also the DIDID estimate. After that, I use three regression models to improve the estimates by including individual demographic variables and location fixed effects. I pay particular attention to two at-risk groups: age 16-19 years old teens not in college and age 20-59 years old adults without a high school education, which are likely to be influenced by minimum wage increase. I find that minimum wage increase has a small and statistically insignificant negative employment effect both for teens with no college education and adults who have no high school education in China during 2011 to 2012. I further re-estimate the employment effect according to different regions of China and even a full range of minimum wage increase. In Eastern China, minimum wage increase had negative effect on both at-risk groups, while the effect is statistically insignificant. But in Central and Western China, minimum wage increase positively promote job opportunities for both at-risk groups. In terms of ranges of minimum wage increasing, I find positive linear relationship with minimum wage and employment of teens and less-educated adults. If minimum wage increase is less than

15%, teens and less-educated adults would obtain more employment opportunities. However, if the minimum wage increases further, enterprises would provide fewer job offers to teens and less-educated adults.

I use the Synthetic Control Method to investigate the research of minimum wage in China for the first time in the literature. I find consistent results with those in the Multivariate Analysis that the minimum wage increase in 2011-2012 decreased the employment of teens while it increased it for less-educated adults.

In this dissertation, my research is based on a typical incident of a minimum wage increase, which means that the results could be different in other scenarios. Minimum wage study in China is an undeveloped topic. This field of study is worth more attention because China is the largest labor market worldwide.

Chapter 2

EFFECT OF BODY WEIGHT ON WAGE IN CHINA

2.1 Introduction

The number of overweight people has increased around the world during the past several decades, especially in developing countries with previously very low prevalence. China was once considered to be one of the most undeveloped nation and obesity was not a problem. Most of the citizens of the country lacked access to large amounts of food, and certainly lacked access to foods containing large amounts of fats. However, after nearly forty years of dramatic economic growth, China is fast catching up with the West in many areas, including the number of people who are obese (Wu 2006). According to a study from the University of Washington (2014), in 2014, more than 300 million people in China were considered to be overweight, and 46 million adults were considered to be obese. Due to the fast economic development within this nation in the past four decades, China ranks second in the world in terms of the percentage of people who are overweight.

Excess weight, especially obesity, is a complex condition that has serious personal health and social effects (Cawley, Rizzo, and Haas 2007; Chou, Grossman, and Saffer 2004b; Condliffe and Link 2014). Obesity negatively impacts almost every aspect of health, such as diabetes, hyper tension, and cancers. In addition, having a large percentage of a country's population that is overweight or obese results in increases in both individual and national healthcare expenses. In 2012, the healthcare costs associated with obesity were responsible for 9.7% of total Chinese healthcare spending (Center for Disease Control and Prevention 2012). Comparing to the United States, in which 21% of total healthcare costs was associated with providing care for conditions related to obesity (Cawley and Meyerhoefer 2012).

Beyond the issue of healthcare costs, obesity also impacts labor market outcomes. In labor markets, body weight affects wages based on assumptions employers make about the abilities of employees. Because the low marginal productivity caused by obesity, employers do not want to hire these wokers, or due to concerns about high health care costs (Averett and Korenman 1996). Wage penalties related to body weight have often occurred in developed countries (Baum and Ford 2004; Brunello and D'Hombres 2007; Wada and Tekin 2010; Cawley 2004; Greve 2008). In developing countries, research has shown that the relationship between a worker's wage and body weight is usually positive, especially for male workers (Schultz 2003a; Dinda et al. 2006; Nguyen, Beresford, and Drewnowski 2007; Yimer and Fantaw 2011; Dinsa et al. 2012; Jha, Gaiha, and Pandey 2013). In this regard, the labor market effects of body weight on wages may not be the same in developing nations as in developed nations.

Research Problem

The issue facing China is that the country's economic growth has meant that more Chinese are able to afford to eat diets that are more in line with their Western counterparts. However, the country's economic growth has not been equal for all Chinese. Citizens in larger urban areas have experienced a major improvement in living and working conditions that has allowed them to move away from highly physical agricultural jobs and to work in more sedentary office environments (Zhai et al. 2009). In more rural areas of the country, however, citizens have not experienced the same level of economic growth as their urban counterparts, and largely continue to work in highly physical jobs and to eat a more traditional Chinese diet with fewer fatty foods (Zhu and Jones 2010). The problem for researchers, health experts, and policymakers is that how body weight influence individual's wage may not be as simple as people who are obese earn lower wages or people who are not obese earn higher wages. Instead, the relationship may be different based on wage levels and even between male and female workers.

Purpose and improvement of the Study

In this essay, my objective is to identify how body weight influence individual's hourly wage in China by using the data from China Health and Nutrition Survey (CHNS). My dissertation contributes to the literature in two aspects. First, I investigate how body weight impacts individual's hourly wage by using the latest CHNS data (through 2011). Second, I adopt an instrumental variable method to account for the endogeneity problem of body weight by using a unique instrumental variable.

Significance of the Study

The primary significance of this study is that even as researchers and health experts have identified that obesity has become a problem in China, there has been little empirical research regarding how body weight affects individual wages, typically hourly wages in China. Many of the research focused on body weight effect are limited to the United States and Europe (Luo and Zhang 2012). My essay adds to the small amount of existing studies in China.

At the same time, my essay addresses the endogeneity problem that has been present in some previous studies. Another aspect of the significance of this study was the effort to move beyond determining the body weight effect in China, and to determine the specific relationship that existed based on different wage levels. Rather than assuming that having a higher body weight would be associated with Chinese workers who earned lower wages, the goal was to determine if the relationship between body weight and hourly wages might change between lower wage earners and higher wage earners.

From a broad perspective, my essay is carried out with a great concern for demonstrating a methodology in which it is possible to examine how body weight affects individual hourly wage in China that would yield highly valid and reliable results, and to therefore justify the methodologies that are used. The in-depth explanation of the methodology used in this study also makes it possible for other researchers to replicate the work performed in this study as a means of testing the results and examining the appropriateness of the results.

Outline of the Study

Following this introduction, Chapter 2.2 is the critical review of the literature related to this study. Literature regarding the economic and social changes that have occurred in China and the existing studies of how body weight affects wage are presented. In addition, literature regarding how body weight impacts individual's hourly wages in the United States is also discussed as a means of understanding how body weight impacts hourly wages in a developed nation, which is a status that China is quickly achieving. The conceptual framework for this study is presented in Chapter 2.3. Then, Chapter 2.4, introduces the data used in this essay and defines the variables of interest, in an in-depth discussion and explanation of the methodology that was used to conduct this study. The whole empirical results are presented in Chapter 2.5. Chapter 2.6 is the conclusion that summarizes the empirical results, and makes recommendations for future research.

The purpose of the chapter has been to motivate the topic, set up the research problem, and indicate my study's contribution to the literature dealing with the effects of body weight on hourly wages of workers in China. In the next chapter, I examine literature that is related to the purpose of this study. This involves a literature review regarding the changes that have occurred in China, and regarding the issue of body weight and wages in the U.S.

2.2 Literature Review

The purpose of this section is to provide an overall review of the existing literature related to the issue of body weight and wages, as well as to the larger changes that have occurred and continue to occur in China from a social and economic standpoint. This chapter begins with background information about the changes that have occurred in China, and then turns to the changes that occur to people's diets and overall health as a nation moves from the developing to the developed stage. Literature regarding how body weight influences individual's wage in the United States is also reviewed as a means of being able to understand differences that exist between developed and developing nations, as well as differences that might exist across different income levels.

2.2.1 Economic and Social Changes in China

Economic Changes

In order to better understand how and why obesity has become a problem in China, it is necessary to examine the changes that have occurred in that country, both economically and socially. For much of the time from the 1700s to the early 1900s, China was engaged in wars that resulted in on-going, widespread famines. Scholars have estimated that a major famine that impacted China in 1849 killed nearly 14 million people, a subsequent famine that occurred from 1876 to 1879 killed another 9.5 million to 13 million people, and further famines occurred in 1935-1936, and 1942-1943 (Ó GRÁDA 2008).

However, Chinese people continued to experience famine and hunger after 1949. The Great Leap Forward from 1957 to 1962 resulted in widespread hunger in the country. Some scholars (Ó GRÁDA 2008) argue that food rationing on the part of the Chinese government had left millions of Chinese with little to eat, which meant that widespread hunger had occurred in the country. The Cultural Revolution of the late 1960s and early 1970s brought more wide spread hunger to the country (Du et al. 2014).

In 1977, China began to implement economic reforms that were intended to increase the economic growth and prosperity of a country that had long been a largely agricultural society with high levels of poverty, and that had been hard hit by years of poor agricultural output (Holz 2008). The outcome of the country's economic reforms, which included a transition away from strict Communism to the inclusion of capitalism alongside more traditional Communist economic principles, was a period of decades of high rates of economic growth (Chen, Yang, and Liu 2010). A country that had once experienced year after year of famine and hunger began to experience year after year of double-digit rates of economic growth. The result was economic prosperity for people who had never known having more than was absolutely needed in terms of food and personal items (Tang et al. 2008).

Unfortunately, what also occurred in China during its rapid increase in economic prosperity was an increase in economic inequality (Tang et al. 2008). Specifically, large economic disparities arose between people who lived in the large urban areas of China, who were able to secure higher paying jobs in technology, banking, and finance and those who lived in the rural areas of the country, where most jobs continued to be in the lower paying agricultural industry (Ding 2002). At the same time, disparities in economic prosperity were identified between coastal provinces where growth in manufacturing and other industries had occurred and inland provinces where growth was much slower because of a lack of new jobs and new industries in those areas (Fan and Sun 2008). The coastal areas of China were areas in which foreign companies wanted to open factories because of the ability to easily move supplies into the country and move finished goods out of the country to consumers around the world (W. Zhang 2001). In contrast, the inland areas of China lacked the transportation infrastructure that made it possible for foreign companies to easily and cheaply move supplies and finished goods.

It is also important to note, however, that the disparities in the regions of the country that were favored by foreign companies who were allowed to open operations in China was not solely a result of proximity to shipping ports. The Chinese government, in an attempt to increase the amount of direct foreign investment into the country, as early as the late 1980s, opened up coastal areas in which foreign companies were granted more freedom to make investments and build factories and other business facilities (Démurger et al. 2002). The result was that the inland areas of the country lagged behind for many years before changes in policies were implemented that opened those areas to more direct foreign investment.

Social Changes

The economic growth that continues to the present time in China has meant that in some parts of the country, people have been able to have more food than they need, as well as a wider variety of foods (Y. Wang et al. 2007). Researchers have claimed that those people have moved from having to eat to live to a situation in which they are actually living to eat because of their new ability to acquire types of foods that were unavailable and unaffordable a few of decades ago (X. Zhang et al. 2008).

The traditional Chinese diet consisted of foods that are high in carbohydrates, such as rice, wheat, and vegetables (H. Wang et al. 2007). The traditional diet would have consisted of those items because they were widely available in China, and because they provided the calories needed to engage in highly physical labor. However, with economic prosperity and a move toward capitalism, segments of the Chinese population have gained access to fast food chains such as McDonald's, more foods that are high in fats and oils, and meat products that were not eaten in high quantities in the recent past (Zhai et al. 2009). For the first time, Chinese consumers have the ability to eat the types of foods that have been common in the western countries for decades.

Once again, the issue of differences between those who live in urban areas and those who live in rural areas of the country cannot be ignored. The rapid rise of the middle class and even upper classes in the large cities of China has had a major impact on the change in dietary patterns in the country. The middle and upper classes in China are viewed as wanting to demonstrate their wealth by showing that they are able to engage in consumption, particularly often consumption that they view as being indicative of Western cultures such as the United States (Elfick 2011). In this regard, being able to purchase fast food and dine in restaurants that serve foods that are high in fats and oils offers a way in which members of the Chinese middle class are able to demonstrate their economic prosperity, as well as their understanding and enjoyment of Western culture.

Researchers have also noted that for Chinese who live in large cities in the country, there has been an increase in daily living experiences, such as within jobs and advertising, that encourage and promote eating more food and engaging in less physical activity (X. Zhang et al. 2008). Many Chinese who live in larger cities work in service-oriented jobs, which means that they generally work in office environments where daily physical activity is at a minimum. However, their busy and middle class lifestyles result in consuming either fast food or higher fat foods as a part of their urban, middle class lives (S. W. Ng, Norton, and Popkin 2009).

From a critical perspective, it is necessary to discuss a larger issue in the literature that has been reviewed, which is the importance of incomes and living conditions in relation to changes in diet that have impacted the body weight of people in China. Chinese people in larger cities have experienced a greater change in economic conditions because of the continued prosperity and economic liberalization of the country (X. Zhang et al. 2008). The move to the middle class for many in the urban areas of China has been a result of obtaining jobs in banking, finance, and other areas of the service sector. Those jobs generally require little physical labor, and when combined with the ability and desire to engage in eating a more Western diet as a means of demonstrating their middle class lifestyles, the result has been increased obesity (S. W. Ng, Norton, and Popkin 2009).

The situation just described may not be the case for those Chinese who live in rural areas of the country or for who still engage in jobs that require high amounts of physical labor. In this regard, how body weight affects individual’s wage may not be entirely based on employers making decisions about the employability of people based on their weight. Instead, as people move up in social class, the change in lifestyle that they experience may be at least one reason for the change in diet and change in body weight.

Even more, the unequal change in the lifestyles of workers in China means that body weight affects individual's wages differently. For workers who live in rural areas, as well as those who work in jobs that require a great deal of physical labor, being overweight or obese might be a detriment because their employers might view them as not being able to efficiently perform the physical duties of labor-intensive jobs. In contrast, workers who live in urban areas and those who work in office environments may not face a problem obtaining employment because of their weight. A person's body weight may not be important to employers who hire people for jobs in office environments in which physical ability is less important than mental abilities.

The examination of the literature on the economic and social changes that have occurred in China has shown the importance of the current study. How body weight affects individual's wages may not indicate that body weight causes higher or lower wages. Instead, larger social issues such as the type of job in which people work, the locations in which they live in China, and even their wages may impact their body weight. What is clearly needed is more empirical research and investigation on this issue, which is the reason that this study was conducted.

The Transition from a Developing to Developed Nation

Beyond understanding the economic and social changes that have occurred in China, it is also important to have a broader perspective about the social changes that occur in countries as they transition from a developing status to being fully developed. China is a country that has certainly achieved great gains in economic and social conditions in the past few decades. However, China is also a country that will continue developing as large portions of the country's population still face hunger and other social problems (Tafreschi 2015). In this regard, examining the broader literature about the social changes that occur in countries that are transitioning from developing to developed nations is useful for understanding the changes that are occurring in China.

One of the differences between developing and developed nations is the socio-economic status of the people within the country who are most likely to be obese. In developing nations, the overweight and obese people are those who are in the middle and upper classes of society (Monteiro et al. 2004). The reason for this is that the increase in weight is due to the change in the financial resources for the middle and upper income workers (Tafreschi 2015). As people move from having only enough to eat, or even having less than enough to eat, to having more to eat, they are likely to consume more food and become overweight or obese. The change in the type of foods that are available, as well as the ability to consume more of those foods results in being overweight and obese. In contrast, poor people in developing nations generally lack the financial resources to consume large amounts of foods, as well as lack access to foods that are high in fats that can cause obesity.

In contrast, in developed nations, a change occurs in which people in middle and upper income levels are actually more health and being normal weight than poorer people (Monteiro et al. 2004). The reason for this is that in developed nations, people with more money are able to purchase higher quality foods that are lower in fat. There is also generally a greater concern about weight from a health standpoint. People with more money have the resources to be more concerned about their health, and are generally less likely to be overweight or obese (Tafreschi 2015).

Researchers have explained that a u-shaped distribution exists regarding the relationship between body weight and wages between developing and developed nations (Philipson and Posner 1999). Specifically, the researchers explain that in poor and developing societies, it is wealthier people who are generally overweight or obese, while in developed societies, it is poorer people who are generally overweight or obese. Researchers have explained that the u-shaped distribution of obesity is because of the change in economic conditions combined with the change in jobs. In developing nations, it is the wealthier people who are able to afford more food while they also move from labor-intensive jobs to less labor-intensive jobs. However, as nations become developed, the relationship between money and food changes; people earning higher incomes purchase more expensive foods that have fewer calories and people earning lower incomes purchase cheap, more calorically dense foods, resulting in heavier weights among lower income people (Lakdawalla and Philipson 2009).

At the same time, as nations become developed, people with higher levels of income generally have more free time and more money with which to engage in sports and other physical activities (Tafreschi 2015). In developing nations, people with higher levels of income may not have the time to engage in physical leisure activities, or they may not be as concerned about such activities. In this regard, the change from developing to developed nations is not merely a change in income distribution, but also a change in eating habits and leisure and exercise activities. These complications are particularly present in a country like China which has been developing for more than a generation but that has not reached fully developed status.

In the case of China, it may be that changes in the type of jobs that people of different income levels perform has impacted their body weight as differences in physical activities in the job environment can result in differences in body weight (Chou, Grossman, and Saffer 2004a). At the same time, it is common within Chinese culture for businesspeople, who generally have higher incomes, to engage in dining and entertainment as a means of conducting business, which means that they are eating more food in general and more fatty foods in particular (Cai, Fang, and Xu 2004). One can speculate that if Chinese businesspeople are focused on spending much of their time engaging in business activities, which often includes eating large amounts of food, and not engaging in physical activities for leisure, then this might result in being overweight and obese.

In contrast, for poorer people in China who engage in more physically demanding labor, the physical appearance of being overweight or obese may not be viewed as an indication of their status as businesspeople, but instead viewed as an indication that are not able to perform the duties required of them. Researchers have found that perceptions about physical appearance, either being perceived as too fat or too skinny, or too tall or too short, can result in not being hired for particular jobs (Schick and Steckel 2010; Case and Paxson 2006) . In this regard, body weight may indeed be an important issue for only a certain segment of the Chinese population.

The importance of the research regarding the changes that occur in countries as they move from developing to being developed in terms of diet and weight is important for this study. China is a country in which obesity is as a major problem (University of Washington 2014). The reason for the epidemic of obesity in China is likely due, at least in part, in that China is changing from being an undeveloped country to the second largest economic power. The country continues to improve economically, but it has certainly not reached developed status. China suffers from great disparities between rich and poor (Tang et al. 2008). Because the country is still a developing nation, it would seem based on the literature, the higher incomes people are more easily to be overweight and obese.(Lakdawalla and Philipson 2009).

The impact of body weight might be more important or have a greater relationship with wages for the poor people than for those with higher incomes. However, the literature that has been reviewed thus far may also be an indication that the how body weight affects individual’s wage involves other variables, and may also not be direct from body weight to wages. Instead, wages may also have an impact on the body weight of Chinese workers because body weight is impacted by the monthly incomes and the types of foods Chinese consumers are able to buy.

What has been demonstrated, yet again, is the need for this study. As noted, obesity has become a problem in China. However, what is not fully known is the relationship between body weight and wages within the country. China is a country that is moving from the developing stage to the developed stage, which means that the how body weight impacts individual’s wage may be somewhere between a developing nation, in which the poor are primarily affected by body weight, and more toward a developed nation, in which the rich are the ones primarily affected by body weight. Furthermore, other factors affect wages that Chinese workers earn beyond body weight.

2.2.2 Body Weight and Wages in China

Keep in mind the social and economic changes that have occurred in China and the changes that often occur regarding diet and work conditions as a country transitions from a developing nation to a developed nation. Xu et al. (2005) investigated the relationship between the average income of families in China and body mass index. The data for the study were obtained using random cluster sampling of people in the Mainland region of China who were at least 35 years old from October 1999 to March 2000. The researchers obtained a final sample of 29,340 participants, of whom 67.7% are holding urban hukou status and 32.3% are holding rural hukou status. The sample was nearly equal between males and females with 49.8% males and 50.2% females. The researchers statistically tested whether the incomes were different based on different BMI categories while controlling for a series of individual demographic variables. They found that obesity was positively related to socioeconomic status. In other words, the participants who had body weights above the healthy weight category based on BMI were more likely to be from higher socioeconomic levels.

Monda, Adair, Zhai and Popkin (2008) investigated the relationship between body weight and occupations in China. The researchers used data from the China Health and Nutrition Survey (CHNS) from 1991 to 2000 survey waves with adults who were ages 18 to 55. They employed random effects method to determine the relationships between body weight and occupations among the respondents. The researchers found that the higher occupational physical activity the lower body weights for both gender[26]. The question might be asked whether the study conducted by Monda, Adair, Zhai and Popkin (2008) is important to this study given that how body weight affects individual's wages was not investigated. Nevertheless, the study is useful because the findings indicate that occupational activity and body weight are related. In this regard, Chinese workers who have higher body weights are likely to be people who work in less physically demanding jobs in office environments. The researchers noted that the technological changes in China have resulted in occupational changes that means that some people have more sedentary jobs, which makes it easy for them to gain weight.

Shimokawa (2008) examined the effects of body weight on the monthly wage rate of Chinese workers using data from 1991—2000. By using the data from CHNS, the researcher employed both parametric and semi-parametric regression techniques to study the effects for both male and female workers. Body size was defined in three different ways: BMI, weight in kilos, and by clinical classification (underweight, normal weight, overweight, and obese). The empirical estimate results show that for underweight workers the wage effect is negative the negative, while for being overweight and obesity the wage effects are mixed. The empirical estimate results of OLS regression imply that underweight and obese male workers face wage penalties. Comparatively, the empirical estimate results of fixed effects model show that being overweight and obese the wage effects are positive. His semi-parametric empirical results imply that for both gender underweight and obese workers face wage penalties. Wage penalties are more sever for male workers than female workers in China.

26 To create a measure of occupational physical activity, the researchers used daily time spent in each occupation.

Gao and Smyth (2010) estimated the relationship between adult height and hourly wage in China in 2005 in order to investigate the return on investments in health human capital. They used the database of the China Urban Labor Survey, which included 12 randomly selected cities, the researchers used a traditional OLS earnings function and the 2SLS method. They found that height had positive effects on individual wages for both male and female workers. They identified “the number of local health institutions” and “location index” as instrumental variables to proxy adult height to control the potential endogeneity. They claimed that these two instruments are valid because they are highly correlated with height and also orthogonal to the residual of the wage equation. In a developing country like China, more local health institutions, a better health care supply chain for individuals, and residence in more prosperous locations results in more nutritional intake and a higher quality of health care. They found that average effects are even larger after they control for potential endogeneity.

Ma (2012) estimated the impact of an individual’s socioeconomic status (SES)[27] associated with being overweight or obese in China. The author used the longitudinal data from the CHNS from 1991 to 2006, and employed a linear regression model to investigate how body weight changes with age and SES. He found that body weight is positively related with individual’s age and is also positively related with SES if the respondents are during childhood, while negatively correlated as children grow up. He also found that respondents from urban areas are more likely to intake

27 The researcher used individual’s education and income as indicators of socioeconomic status.

higher calories food than those who from rural, in that the huge economic development gap between urban areas and rural areas in China.

Luo & Zhang (2012) investigated how body weight impacts the Chinese labor market by using the measure of body weight with body mass index, and they employed the database of the China Family Panel Survey (CFPS), a database that contained responses to a variety of questions about demographic, economic, and health conditions from 14,000 households in 24 provinces. The researchers used OLS regression to investigate how body weight affects the labor outcomes. They found that the relationship between body weight and monthly wages is non-linear. Specifically, being underweight or overweight resulted in lower wages compared to being what was considered to be of normal or average weight according to the body mass index. The researchers noted that this relationship was stronger for women than for men.

Zhang (2012) conducted a study to examine both the determinants and patterns of obesity among adults in China. The researcher used a multi-level framework with data from the 2006 wave of the CHNS. He found that on an individual level, both income and wealth were positively associated with body weight, meaning that higher income and wealthy people had higher body weights. However, on an area level, people who lived in areas that had lower levels of poverty had a lower chance of being obese. At the same time, people who lived in urban areas were at a greater risk for being obese.

The results of the study conducted by Zhang (2012) seem to indicate that China may have similar characteristics with regards to the likelihood of people being obese as in countries such as the United States. Based on those findings, people who lived in urban areas were more likely to be obese. At the same time, people who lived in areas with less poverty were less likely to be obese. The findings would seem to demonstrate that China faces a situation in which living conditions and economic conditions work together to impact body weight. On a broader level, those findings might also indicate that how body weight affects individual's wage is not as simple as a person's body weight impacting the type of job he or she obtains, and, in turn, the amount of money that is available to purchase food.

Pan, Qin and Liu (2013a) examined the relationship with body weight and rank of employment in the Chinese labor market by using the national data of Urban Resident Basic Medical Insurance Survey (URBMIS) from 2007 to 2010. They defined the individual's weight by continuous BMI and dummy variable clinical classifications. They defined a new variable, "community body weight prevalence," as the instrument to control for the body weight endogeneity. The variable is defined as the weighted BMI from the respondent living in the community. They claimed it was a valid instrument because individual body weight was easily affected by peer group and surrounding environment, so that they are highly correlated with individual body weight and uncorrelated with the residual of employment equation. The researchers found that if BMI is relatively lower it is positively related the employment likelihood and negatively related if BMI is relatively higher. This was true for both male and female workers. They also found that underweight, overweight and obese workers are usually in the low salary sectors, except for overweight male workers.

Xiao et al. (2013) employed a multilevel research to explore the relationship between socioeconomic status and obesity among adults in China. The researchers used education and income as indicators of SES and used BMI to measure obesity. They performed a two-step logistic regression analysis that controlled for gender. The results showed that among women, an inverse association existed between education and obesity, meaning that less-educated female workers were easily being obese. For men, a positive association existed between education and obesity, meaning that educated male workers were easily being obese in China. The results of the study conducted by Xiao et al. (2013) provide more findings to support the idea that the Chinese population is experiencing changes in obesity and wages in relation to the larger social and economic changes that are occurring. As the country transitions from a developing nation to a developed nation, a u-shaped relationship may exist in which the how body weight affects individual's wage may be different for people at lower income levels when compared to people at higher income levels.

Xie and Awokuse (2013) conducted a study on how health status affects individual income in China and improved upon a previous study by using individual income rather than household income. The researchers used data from the CHNS from 1991 through 2006. People with better health had higher individual income levels than people with poorer health conditions. The researchers also argued that household income is unlikely to be appropriate because if one person within the household in China earns less money, then other family members may increase their work in order to compensate for the loss. This is an important issue for Xie and Awokuse, and it is the reason why individual income rather than household income is appropriate. The use of household income as a measure of wages may measure larger family dynamics.

Tafreschi (2015) investigated the relationship of the income gradient and individual body weight in China from 1991 to 2009 and explained how income influences an individual's future body weight. He employed the data of the CHNS to investigate the income body weight gradient by a linear growth regression, and he employed a lagged weight variable to control for potential endogeneity problem. The researcher found that higher income is positively related to personal body weight in less developed areas (non-coastal provinces) while negatively related to BMI in more prosperous areas (coastal provinces). He also claimed that the ratio of overweight people in low income occupations is lower in more developed regions of the country.

Overall, the research regarding how body weight affects individual's wage in China is limited. It might also seem that the literature is fairly clear on the way in which body weight impacts wages. The reality, however, is that there are important gaps and limitations in the existing literature. One of those important gaps is that the most current data from China have not been used, which may show more change in terms of the differences of how body weight affects individual's wage. Furthermore, the endogeneity problem was addressed in some, but not all of the previous studies which represents another area in which further investigation is appropriate.

More specifically, my essay improves upon the methods used in previous studies in several ways. First, my essay builds upon and extends previous analyses by using the latest CHNS data, which is through 2011, to estimate the effect of body weight on individual hourly wages. A unique instrumental variable was used in this study to control the endogeneity issue. By combining these methods and areas of concern, the results of my essay can provide both the most current information possible, as well as highly valid and reliable findings.

2.2.3 Research in the United States

The literature reviewed about how body weight affects individual's wage in China has included ideas about how the diet of certain segments of the Chinese population is becoming more like that of people in the United States. Because that huge social and economic changes that are occurring in China, including changes to the diets and lifestyles of some segments of the Chinese population, it is useful to understand the body weight effects in United States as a means of comparing what has been learned about China, and what the results of my essay may show.

Averett and Korenman (1996) used a sample of respondents aged 23 to 31 from the 1988 National Longitudinal Survey of Youth (NLSY) to investigate hourly wage differentials by using the measure of body size with body mass index. The researchers estimated differences in the hourly wages of people aged 23 to 31 and found that the body weight effects for female workers were significant while it was insignificant for male workers. They focused on the marriage market and they found that obese female workers were more likely to have wage penalties. They also used same-sex sibling differences to control for potential endogeneity bias. They confirmed that family background differences did not account for the social and economic disadvantages experienced by obese women.

What has been demonstrated is the role that gender may play with regards to the effect of how body weight affecting wages in China. As China transitions into a developed nation, obesity among men may not be viewed as being as important an indicator on job performance ability as it appears to be for women. In fact, Cawley (2004) conducted a study on how body weight affecting wages that extended the previous studies in three aspects. First, the researcher used a larger sample. Second, the researcher used a sibling's weight and height as variables in order to determine if those factors had some effect on wages. Third, the researcher performed an examination of differences across races and ethnicities as well as genders. The results of the study showed that for white female workers the body weight effect is significantly negative and overweight and obese white females face wage penalty.

Baum and Ford (2004) also investigated how obesity affected wages based on gender in the United States. The researchers found that for both genders experienced wage penalties at the first ten years of their working careers. As younger people began their careers, they were judged based on their weight, and people who were obese earned lower wages than people who were not obese. Based on their findings, the researchers claimed that the factors affects workers' wages include individual's behavior pattern and health factors. Another possibility is that there are other factors that have an indirect impact on how body weight affecting worker's wages.

The study conducted by Baum and Ford (2004) also raises the issue of how age might impact the issue of how body weight affecting wages in China. It is possible that older people in China will earn more money and have less physically demanding jobs, so obesity may not actually have a large role in their wages. However, this may not be the case at all. Even more, younger people, both males and females, may face a greater negative impact on their wages if they are obese regardless of the type of jobs they perform. At the same time, simply because China is transitioning into a developed nation, how body weight affecting wages may not be the same as in the United States.

Once again, what has been demonstrated is the need for this study. As China makes the transition into its status as a developed nation, there are many unanswered or not fully answered questions about how body weight affecting wages. One of those questions is whether China is following the same path as the United States has in terms of how being overweight or obese impacts the wages of workers. Another question that has not been addressed in the previous literature from China is whether age and gender are significant variables for all workers, or only for workers within certain income brackets.

Han, Norton, and Sterns (2009) investigated how body weight influenced an individual's employment and hourly wage rate. They employed the data of the National Longitudinal Survey and used individual fixed effects method to control the body weight endogeneity problem. They found that the body weight effect on an individual's wage is negative and this effect is larger in interpersonal skills required occupations. In addition, the negative body weight effects increased with a respondents' age.

Dahan (2010) estimated how body weight affecting wages by employing two data sources, the National Longitudinal Surveys of Youth NLSY 79 and NLSY 97, to explore differences across gender and race in the U.S. The author found that white female workers face wage penalties as their body weight increased. In other gender and ethnic groups the negative body weight effects were also been observed. The author claimed that except for black male workers, all other gender and ethnic groups face wage penalties.

Overall, the research from the United States that has been reviewed has certainly raised issues of gender, age, and even the type of occupation in which people work as being factors that may impact the body weight effect on wages when examined different countries, namely, China. As the United States is a developed nation, and China is transitioning into a developed nation, these factors may also influence the body weight effect in China. At the same time, as China is still a developing nation, how body weight affecting wages in the United States might not be similar at all to that relationship in China.

2.3 Conceptual Issues

Based on the survey of the literature, a conceptual framework was chosen to serve as the foundation and the methodology of this dissertation. Figure 1 shows the causal relationship of body weight and wage. Intuitively, normal weight workers usually earn higher wages than others because they are more productive and without health problems. Normal weight workers would be more capable in lots of kind or amount of work than other workers. Discriminations may occur in workplaces from employer or customers to overweight or obese workers. In this way, overweight or obese workers may find it more difficult to obtain jobs or to gain promotions in the companies for which they work, and they may be more readily discriminated against. This may be particularly true in industries in which appearance is considered important such as the retail or entertainment industries (Baum and Ford 2004; Madden 2004).

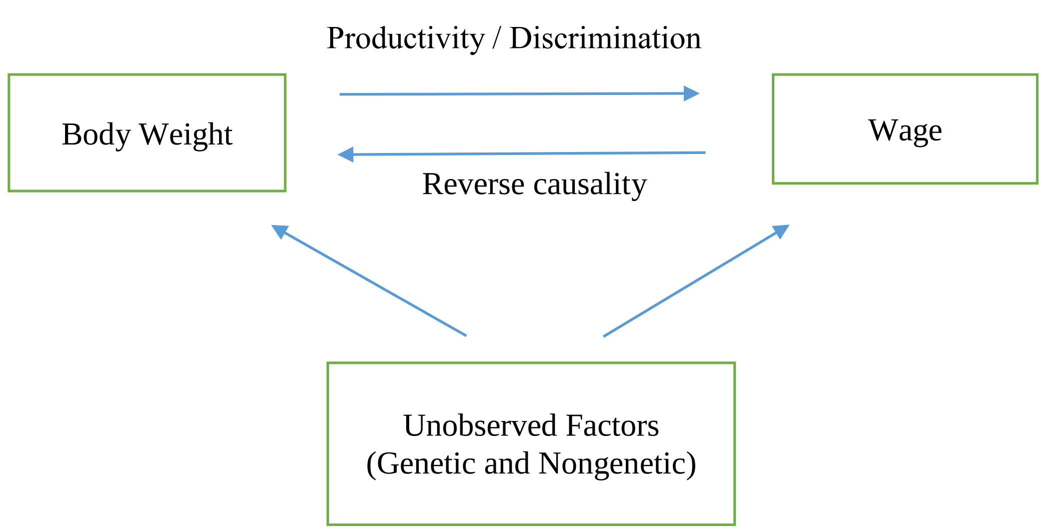

Figure 2.1: Body Weight and Wage

The formalization of how body weight affecting individual's wage is shown in equation 2.1

$$\ln W_{it} = \alpha B_{it} + \beta X_{it} + \varepsilon_{it} \quad (2.1)$$

In this equation, the dependent variable is the natural log of the wage for individual i at time t; B_{it} is the individual i body weight at time t; X_{it} is a vector of other observed explanatory variables and ε_{it} is the error term. If all explanatory variables are independent of the error term, then the OLS results of α is consistent. However, even if the variables in X_{it} are independent of the error term, body weight and the residuals could still correlated and leads to biased OLS estimates (Schultz 2003b; Cawley 2004). Furthermore, some unobservable factors such as ability and self-motivation are correlated with body weight and wage level. There also may be reverse causation since the wage could affect body weight by the diet habits and lifestyles. Each of the above these suggests the existence of the endogeneity problem.

According to Comuzzie and Allison (1998), genes only explain roughly half of the variation in individual body weight. While the rest is explained by nongenetic factors such as individual choices and environment. Cawley (2004) reviewed the potential endogeneity problem and proposed the following model shown in equation 2.2:

$$\varepsilon_{it} = G^{w}_{it} + NG^{w}_{it} + \nu_{it} \quad (2.2)$$

The wage residual in equation 2.1 can be divided into two aspects: genetic component G^w and anon-genetic component NG^w. The superscript w denotes the unobservable factors that affect wages. For example, economically myopic workers who take more attention on present lifestyle and have low self-motivation and unambitious to seek more opportunities in the future career.

Body weight may be influenced by wages and personal characteristics as shown in equation 2.3:

$$B_{it} = \gamma W_{it} + \beta X_{it} + \Phi Z_{it} + \tau_{it} \tag{2.3}$$

If the coefficient γ is nonzero, wages may also affect individual's body weight reversely. For example, in developing countries like China, low income family cannot afford daily life consumption and as a result, be underweight. As family income increases, however, Chinese people are dining out more often in restaurants and more likely to be overweight (Lin and Frazao 1997). In high-income countries, poor families usually consume more fatty and high calorie food and become overweight. Therefore the reverse effect of wages on body weight indicates the existence of endogeneity issue.

$$\tau_{it} = G^{B}_{it} + NG^{B}_{it} + \psi_{it} \tag{2.4}$$

In equation 2.4, the residual in Equation 3 is divided into two aspects: genetic component G^{B} and non-genetic factors NG^{B}. Superscript B denotes the unobservable factors that affect body weight. For example, the tastes and preferences of Chinese people vary across the country. Residents from cold northern China prefer wheat-based products and fatty food so that their body weight would increase and become overweight. People living in the warm southern China prefer rice and health food, so that southerners' body weights are more likely to be normal.

Therefore, the conceptual issues involve the endogeneity of body weight. Current wages may affect current body weight, which means γ is non-zero. If G^w and NG^w are correlated with G^B NG^B respectively, unobservable factors would exist and connect wages and body weight. Both scenarios imply that the OLS assumption that body weight in Equation 1 is exogenous is violated and causes a biased estimate.

While this conceptual framework may seem somewhat complicated, it reflects that how to deal with body weight affecting wages is not easy in China. Simply investigating how body weight affecting wages would certainly be easy, but it would also be inappropriate given the larger issues that have been identified in previous studies in both China and the United States. The fact that China is transitioning from a developing to a developed nation means that a larger set of issues may be at work as part of how body weight affecting wages. The conceptual framework employed in this dissertation will be an improvement in the methods used in previous studies relating to China. I use the latest data that are available in order to determine how body weight affecting wages in China.

2.4 Data, Variables and Methodology

The purpose of this section is to discuss the dataset and variables used in this study and then provide an in-depth explanation of the methodology used to investigate how body weight affects workers' wages in China. This chapter begins with a data description. Next, I list a series of variables employed in this dissertation. After that, the methods used in this study to control for the endogeneity problem are discussed. The methods used to estimate how body weight affecting individual's hourly wages of

Chinese workers include: OLS, OLS with lagged weight, fixed effects models and instrumental variables models.

2.4.1 Data

The data underlying this dissertation are from the China Health and Nutrition Survey (CHNS), which is a cooperative project with the University of North Carolina and the Chinese Center for Disease Control and Prevention. The survey is an ongoing longitudinal survey conducted in nine provinces of China, which includes Guangxi province, Guizhou province, Henan province, Hubei province, Hunan province, Jiangsu province, Liaoning province Shandong province and Heilongjiang province. The survey began in 1989 and eight more waves have been conducted in 1991, 1993, 1997, 2000, 2004, 2006, 2009, and 2011. The survey is longitudinal in nature and comprises questions at the individual, the household, and the community level.

2.4.2 Dependent Variable

The dependent variable in this dissertation is the natural log of the individual's hourly wage in Chinese Ren Min Bi (RMB). In the CHNS survey, only the average monthly wages of respondents were collected in each survey year. The hourly wage for each individual is calculated by dividing the monthly wages by monthly hours. Weekly hours equal the hours worked per day multiple the number of days per week. Then monthly hours are obtained by multiplying the weekly hours by four[28]. Then I divide the monthly wages by monthly working hours to obtain the hourly wage. The

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28 Because weeks per month are not reported in in the data, I assume that the respondent works 4 weeks.

hourly wage is adjusted for inflation and is represented in 2011 Chinese RMB. Extreme outlier wages are excluded. These include individuals in the lowest 5% of the wage distribution and those whose wages were 3 standard deviations above the mean wage. I will present the statistics of adjusted hourly wage and log hourly wage in the next chapter.

2.4.3 Explanatory Variables

Body weight

Body mass index (BMI) is used as one of the measures of body weight, which is defined as body weight (kilograms) divided by height squared (meters). Each respondent's body weight and height are available in the CHNS survey which followed standard measurement techniques. Body weights of participants were measured to the nearest tenth of a kilogram and heights were measured to the nearest tenth of a centimeter. In order to make sure the precision of the measurement, participants wearing indoor clothing and without shoes. Two survey workers collected the measurement data, one worker undertook the measurement and the other worker recorded.

The BMI standards used to define being overweight and obese by the thresholds according to China Centers for Disease Control and Prevention (2012), the World Health Organization (WHO), and the U.S. National Institute of Health. The most commonly used measures of body weight are BMI as a continuous variable, as well as an indicator variable for clinical classification. The specific classifications of BMI are underweight, if BMI is less than 20; healthy weight, which is a BMI greater than or equal to 20 and less than 25; overweight, which is a BMI greater than or equal to 25 and less than 30; and obese, which is a BMI greater than or equal to 30. In

China, the cutoff points of BMI for weight classification is lower. According to Chinese standards, underweight is a BMI of less than 18.5; normal weight is a BMI greater than or equal to 18.5 and less than 24; overweight is a BMI greater than or equal to 24 and less than 28; and obese is a BMI greater than or equal to 28. The comparisons of the WHO standards and the Chinese standards are shown in Table 2.1. In this essay, I focus on how body weight affects individual wages in China. Therefore, I follow the Chinese standard to define the clinical classification of weight.

Table 2.1: Clinical Classification of Weight based on BMI

	Underweight	Normal weight	Overweight	Obesity
WHO standard	BMI<20	20≤BMI<25	25≤BMI<30	BMI≥30
Chinese standard	BMI<18.5	18.5≤BMI<24	24≤BMI<28	BMI≥28

Note: The classification is from World Health Organization and China Center for Disease Control and Prevention (2013)

The three measures of body weight used in this dissertation include BMI and body weight in kilograms as continuous variables; and the clinical classifications of underweight, normal weight, overweight, and obese. I choose normal weight as the reference category. To avoid extreme outlier for BMI, I deleted observations that are more than 3 standard deviations from the mean. I will present the detailed statistics in the next chapter.

Table 2.2 and 2.3 present the percentage distributions of Body Mass Index (BMI) for males and females from the CHNS survey data respectively. In Table 2.2, 58.13 percent of males have a normal weight. 5.05 percent of males are underweight and 7.73 percent are obese. About 30 percent of the sample of males is overweight.

Table 2.2 also presents the percentage distribution of BMI for different regions of China. I find that in the coastal region, which is the most prosperous and economically developed region of China, the proportion of overweight or obesity is higher. In the Central region, the highest proportion of normal weight is male workers.

Table 2.2: Percentage Distribution of Body Mass Index for Males from 1989-2011 in China

Males	Full Sample	Coastal Region	Central Region	Other Region
Underweight	5.05%	3.94%	5.41%	6.87%
Normal weight	58.13%	53.18%	63.26%	58.47%
Overweight	29.09%	33.07%	25.50%	27.64%
Obesity	7.73%	9.81%	5.83%	7.03%

Notes: Data from CHNS 1989-2011. Coastal region includes Liaoning, Shandong, Jiangsu provinces; Central Region includes Henan, Hubei, Hunan, Guangxi provinces; other region includes Heilongjiang and Guizhou provinces.

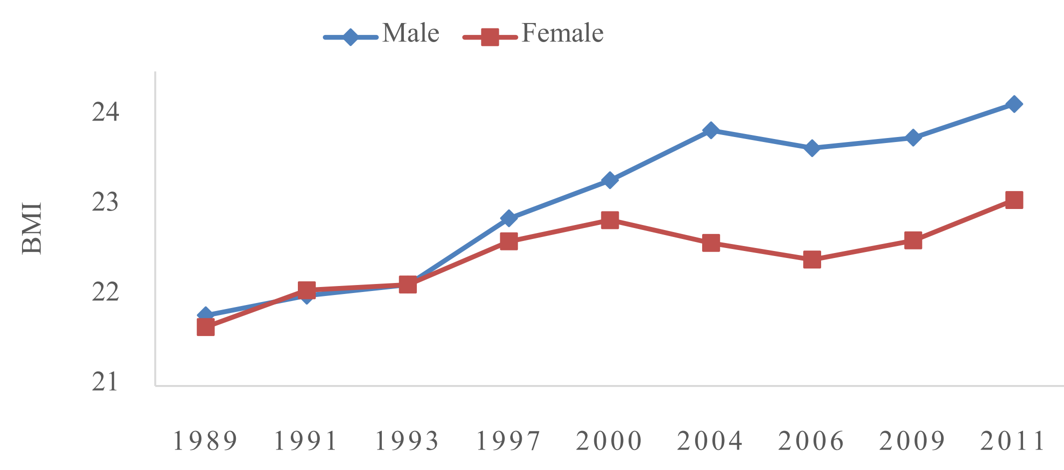
Table 2.3 shows that 64.19 percent of females have a normal weight. As a percent of the sample, 7.07 percent of females are underweight and 5.49 percent are obese. About 23 percent of the sample of females is overweight. Table 2.3 also shows the percentage distribution by BMI for females according to regions in China. Females in the coastal region have higher proportion in overweight or obesity, which is consistent with that of males. The highest proportion of normal weight females is in the Central region, which is same with that of normal weight males. A possible hypothesis for this finding is that the Central region is less developed than the Coastal region and more developed than other regions economically. Thus, respondents from the Central region are more likely to have a normal body weight.

Table 2.3: Percentage Distribution of Body Mass Index for Females from 1989-2011 in China

Females	Full Sample	Coastal Region	Central Region	Other Region
Underweight	7.07%	6.08%	7.88%	7.76%
Normal weight	64.19%	61.36%	66.75%	65.65%
Overweight	23.24%	25.45%	21.43%	21.73%
Obesity	5.49%	7.11%	3.94%	4.86%

Notes: Data from CHNS 1989-2011. Coastal region includes Liaoning, Shandong, Jiangsu provinces; Central Region includes Henan, Hubei, Hunan, Guangxi provinces; other region includes Heilongjiang and Guizhou provinces.

Figure 2.2 shows the trend of average BMI of males and females from 1989 to 2011. In Figure 2.2, the average BMI of males has increased in two decades and the trend continues upward except for a small decline during 2004 and 2006. Before 2004, the increase is higher and after 2006, the increase slows down. After 2009, the increase is higher once more. The BMI increased from 22 to 24 during the two decades covered by this study. The average BMI of females had been rising during the 1990s, and gradually declined from 22.8 to 22.4 after 2000. After 2006, the BMI of females continued to increase. The BMI trend of males and females follows the same pattern and increased about 2 points for males and 1 point for females over the twenty years in this data set.



SOURCE: CHNS 1989-2011

Figure 2.2: Average BMI for Males and Females from 1989-2011 in China

Age

Since studies show that weight tends to increase as people age, it is necessary to control for this in the wage equations. Age enters the regressions as a continuous variable. The sample includes participants ages 18 through 60. Age square is also included in the regressions to pick up the possibility of an increase and then decrease of wages as person's age.

Education

In the CHNS survey data, respondents were asked about the highest education level they achieved. The education variable is defined four levels, which are elementary school education, middle school education, high school education and college education. In China, nine years of education, including elementary and middle school education is mandatory and free for all. In my study, the education variables are dummy variables where elementary school education serves as the reference category.

Region of residence

This variable is coded into three regions, which are Coastal, Central, and Other. The Coastal region is the most developed and prosperous region of China and includes the provinces of Liaoning, Shandong, and Jiangsu. The provinces of Henan, Hubei, Hunan and Guangxi are in the Central region. The Other region includes Heilongjiang and Guizhou provinces. The Coastal region serves as the omitted variable.

Marital status

The marital status of each respondent, whether he or she was married, never married, or other (widowed or divorced) at the time of the survey was collected during 1989-2011 surveys. I create a dummy variable that if the respondent was currently married, the values of dummy variable is one, all others[29] are unmarried people and serve as the omitted variable.

Urban Hukou Status

In China, hukou is a unique household registration system. It collects detailed individual biographic data and identifies people as a resident of urban area or rural area.The Hukou system has connections to how the government assigns benefits through social programs. In China, if a person lives in an urban area he holds urban Hukou status. Otherwise, if he resides in a rural area, he or she has rural Hukou status.

[29] For male respondents, 27% are never married, 7% are divorced and 2% are widowed. For female respondents, 29% are never married, 8% are divorced and 2% are widowed.

People with urban Hukou status have privileges in regard to education, medical assistance, health insurance, and other benefits which people with rural Hukou status do not have. In this study, the urban status variable assumes the value of one if the respondent lives in an urban area and holds urban Hukou status. Otherwise, residence in a rural area and the respondent holding rural Hukou status serves as the omitted variable.

Medical Insurance

The healthcare system in China consists of both public and private medical institutions and insurance programs. The number of people who have basic medical insurance has been expanded gradually during the last two decades[30]. In the CHNS survey data, respondents were asked if they had medical insurance. I create a dummy variable that if the respondent has health insurance, and the value of the dummy variable is one.

Ethnicity

The respondent is categorized as Han, or ethnic minority. Individuals classified as Han, number over 1.3 billion people and constitute approximately 91.6% of the population of China, which is the largest ethnic group worldwide[31]. There are 55 ethnic minorities in China, the members of which make up the non-Han Chinese population. Ethnic minorities have equal rights to Han in China and in certain circumstances they hold privileged rights over those afforded to the Han Chinese, as

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30 The number of people who have basic health insured increased from 237 million in 1998 to 956 million in 2010. (Zhao 2015)

31 CIA Factbook: “Han Chinese make up 91.6%” out of a reported population of 1.355 billion (July 2014 est)

they are exempted from the One-Child policy[32] and they have more opportunities to gain an education. In my study, the variable ethnicity is set as a dummy variable. The value of the dummy variable is one if the respondent is Han ethnic. Ethnic minority status is the reference category for this variable.

Instrumental Variable

The instrumental variable used in this dissertation is based on the question dealing with the difficulty in running one kilometer (variable number U157 in the survey). Respondents answered "yes or no." To qualify as a valid instrument the variable should be correlated with respondent's body weight and uncorrelated with respondent's hourly wage. I will test this variable in two stage regressions in the next chapter. In the first stage, I will test if this variable is statistically significant in the individual body weight regression. Secondly, a valid instrument must be uncorrelated with respondent's body weight in the wage equation. If both requirements are satisfied, this variable can be regarded as a valid instrument. The detailed analysis is presented in next chapter. If the variable is a valid instrument, it is set as a dummy variable, and if the respondent does not have difficulty running one kilometer, the value of the dummy variable is one; otherwise the value is zero.

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[32] The policy ended nationwide in 2015.

2.4.4 Methodology

Pooled OLS Regression

The first part of the data analysis involved the use of a pooled OLS regression by employing the CHNS survey data. The formula for the pooled OLS model is shown in equation 2.5:

$$LnW_{it} = \beta X_{it} + \varepsilon_{it} \tag{2.5}$$

where LnW_{it} measures for individual i in time t; X_{it} is a vector of independent variables including the weight variable, β is a vector of coefficients. In addition, ε_{it} is a conventional error term that consisted of only the random component. With the existence of endogeneity of body weight, the OLS coefficients are likely to be inconsistent and biased.

OLS with Lagged Weight

My first methodology used to deal with the body weight endogeneity issue is to replace the weight variable with its lagged value using the same regression model shown in equation (2.5). This method of accounting for reverse causality is that I assume lagged weight is uncorrelated with the current wage residual and current wage residual and lagged weight wage residual is uncorrelated. Cawley (2004) uses the approach to replace current weight with counterfactual 7-year lagged weight in the OLS regressions to correct for the endogeneity. Cawley uses a 7-year lag because the dataset he used was frequently collected so that a 7-year lag was possible for most of the resulting data. The CHNS survey data I use in my dissertation was launched in 1989 and eight more waves of the panel survey through 1989 to 2011. I focus on the CHNS data after year 2000 and use a 5-year time interval in OLS lagged weight regression. That means in the 2011 data for each individual respondent, I use the weight variable from 2006; in the 2009 data for each individual respondent, I use the weight variable from 2004; and in the 2006 data for each individual respondent I use the weight variable from 2000. The last year is obviously 6-year but the CHNS data limited us to look at that interval. Because the CHNS is a longitudinal data source, it is possible to construct the lagged weight value from each previous survey wave. This approach removes current wage effects on body weights, but it does not account for the fact that genetic and non-genetic factors of current wage and lagged weight might be correlated.

Fixed-Effects

The second approach to deal with the body weight endogeneity issue it to employ fixed-effects model. In this section, I describe the basic statistical framework underlying the fixed effects regressions. The form of fixed-effects regression as follow:

$$LnW_{it} = \gamma X_{it} + \alpha_i + \varepsilon_{it} \qquad (2.6)$$

Where $E[\varepsilon_{it}]=0$ and $Var[\varepsilon_{it}]=\sigma_{it}^2$

LnW_{it} measures the natural log of the wage, X_{it} is a vector of independent variables including body weight variables, and ε_{it} is the residual. Variable α_i is individual effects and are assumed to be constant between periods of time. Initially I assume ε_{it} is uncorrelated with X_{it} and it is zero mean and constant variance. Then the estimate result of γ from the OLS regression is consistent. Intuitively, the individual effects as unobservables in α_i might affect wages. These unobservables might include such things as ability and motivation. For example, suppose that persons with high motivation or ability are likely to control themselves and also their body weight to be overweight or obese, and these self-motivated people probably have higher wages. Using OLS, and not controlling for unobservables through fixed effects, the estimate of body weight effects on wage would be biased, which is referred as the omitted variable bias problem. To solve the problem of coefficients bias coming from "individual effects," I follow Baum and Ford (2004), and Cawley (2004), to employ fixed-effects method to deal with the body weight endogeneity issue.

The fixed effects model is based on the assumption that there are constant terms over time for each individual. We cannot directly observe the constant and non-stochastic terms within α_i, but we can get rid of this time-invariant unobserved individual effect by subtracting the mean values of the variables on a given individual. Considering that CHNS is a panel data and our study covers around twenty years, it is necessary to include a time fixed effect into Equation (2) to control for shocks in different time periods. I will create dummy variables for each wave year with the first year the omitted group.

Instrumental Variable Strategy

The primary concern with the fixed effects approach is that the assumptions are likely to be violated if unobservable factors like innate ability and motivation vary over time. For example, a higher quality education could improve an individual's ability to manage weight and personal health, and a higher quality education could also increase the probability of obtaining higher wages. Given the fact that unobservable factors are likely to change over time, the third approach to deal with the body weight endogeneity issue is to introduce a variable as an instrument in an instrumental variable estimation, which assumes that this instrument is uncorrelated with wage residual.

Xie and Awokuse[33] (2013) while using the CHNS data, employed "difficulty in running one kilometer" as an instrument for health status to investigate the causal effects of health status on individual income to account for the endogeneity problem. Inspired by their study, I use the same instrumental variable, "difficulty in running one kilometer," to explore the relationship between body weight and the worker's hourly wage. To be a valid instrumental variable, two conditions must be true. First, the instrument must be correlated with BMI. Second, the instrument must be uncorrelated with the wage equation residual. The variable "Difficulty in running one kilometer" was used as an instrumental variable for individual body weight.

In my dissertation, I investigate how body weight affecting individual's hourly wage by using OLS and three approached to control the potential body weight endogeneity issue. Empirical results are shown in the next section.

[33] They used the same data source CHNS (1989-2006) to investigate how health status affects individual wage

2.5 Empirical Results

In this section my objective is to estimate how body weight affecting individual's hourly wage workers in China based on CHNS data from 1991 to 2011. The outline of the chapter is as follows. Section 2.5.1 shows and discusses descriptive statistics. Section 2.5.2 discusses the empirical results by gender through various regression methods: OLS, lagged OLS, fixed-effects (without and with a time fixed effects) and an instrumental variable regression.

2.5.1 Summary Statistics

I present the descriptive statistics for males and females in Table 2.4 and 2.5 respectively. In Table 2.4, the mean BMI of males is 23.71, weight is 67.72 kilograms, and height is 1.69 meters. The mean hourly wage (2011 Chinese RMB) is ¥16.19[34]. More than 50% males have normal body weight and less than 40% are overweight and/or obese. The average age for male workers is 33.2 years. Around 50% of male workers have less than high school education and 17% of males have a college education. More than 60% of male workers are married, and 90% of male workers are categorized as Han. For males, one third live in the coastal region and the rest live in central and other regions. Around 70% of male workers have medical insurance, and 46% male workers hold urban Hukou status. Unfortunately, information of the potential instrument "difficulty in running one kilometer" is available for only 4,369

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[34] 16.19 Chinese RMB equals to 2.46 US Dollars at the 2011 exchange rate. According to Euromonitor, average hourly wage was around 2.7 US Dollars in 2011, which is similar to the data I used in this essay. Therefore, the average hourly wage in my essay is reasonable. https://www.quora.com/What-is-the-average-hourly-rate-for-a-factory-worker-in-China

observations of the male sample of 9,346. As a result, I will, in addition to estimating the models for the sample of 9,346, estimate them for the sample of 4,369.

Table 2.4: Summary Statistics for Males

Variable	N	Mean	Standard Deviation	Minimum	Maximum
Adjusted Hourly wage (RMB)	9,346	16.19	15.11	3.68	313.97
Log wage	9,346	2.79	0.65	1.79	5.16
Weight/kilograms	9,346	67.72	10.77	36.71	135.23
Height/meters	9,346	1.69	0.28	1.56	1.88
BMI	9,346	23.71	3.27	15.08	38.26
BMI (lag)	2,316	23.06	3.05	15.49	36.96
Weight (lag)	2,316	65.86.	9.43	37.69	130.63
Underweight	9,346	0.05	0.22	0	1
Normal weight	9,346	0.58	0.39	0	1
Over weight	9,346	0.29	0.25	0	1
Obese	9,346	0.08	0.27	0	1
Underweight (lag)	2,316	0.06	0.25	0	1
Normal weight (lag)	2,316	0.62	0.38	0	1
Over weight (lag)	2,316	0.25	0.23	0	1
Obese (lag)	2,316	0.07	0.21	0	1
Age	9,346	33.2	9.5	18	60
Married	9,346	0.64	0.36	0	1
Ethnicity Han	9,346	0.90	0.31	0	1
Medical Insurance	9,346	0.69	0.56	0	1
Coastal Region	9,346	0.34	0.26	0	1
Central Region	9,346	0.44	0.28	0	1
Other Region	9,346	0.22	0.39	0	1
Urban Hukou	9,346	0.46	0.50	0	1
Elementary School	9,346	0.14	0.23	0	1
Middle School	9,346	0.38	0.16	0	1
High School	9,346	0.31	0.25	0	1
College Education	9,346	0.17	0.33	0	1
Difficulty in running one kilometer	4,369	0.42	0.28	0	1

Source: Data from CHNS 1989-2011

Table 2.5 shows the summary statistics for females. The mean BMI for females is 22.26, weight is 57.70 kilograms, and height is 1.61 meters. The mean hourly wage (2011 Chinese RMB) is ¥15.56[35]. More than 60% of females have normal body weight and around 30% are overweight and/or obese. The average age for female workers is 29.3 years. More than 50% of female workers do not have a high school education and 15% of females have a college education. More than 60% of female workers are married, and 90% of female workers are classified as Han, which is close to the figure for male workers. For females, one third people from the coastal region and the rest people from the central and other regions. For females, 70% have medical insurance, and 54% female hold urban Hukou status. Unfortunately, information in the potential instrument "difficulty in running one kilometer" is available for only 2,678 observations of the female sample of 6,136. As a result, I will, in addition to estimating the OLS results based on the sample of 6,136, also estimate the models based on the sample of 2,678.

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35 15.56 Chinese RMB equals to 2.36 US dollars at the 2011 exchange rate.

Table 2.5: Summary Statistics for Females

Variable	N	Mean	Standard Deviation	Minimum	Maximum
Adjusted Hourly wage (RMB)	6,136	15.56	14.63	3.23	272.85
Log wage	6,136	2.75	0.68	1.65	5.03
Weight/kilograms	6,136	57.70	9.82	32.35	114.16
Height/meters	6,136	1.61	0.26	1.50	1.76
BMI	6,136	22.26	3.89	14.38	36.85
BMI (lag)	1,521	21.78	3.67	14.95	35.56
Weight (lag)	1,521	56.45.	9.13	33.63	110.15
Underweight	6,136	0.07	0.26	0	1
Normal weight	6,136	0.62	0.48	0	1
Over weight	6,136	0.24	0.42	0	1
Obese	6,136	0.07	0.23	0	1
Underweight (lag)	1,521	0.08	0.29	0	1
Normal weight (lag)	1,521	0.64	0.47	0	1
Over weight (lag)	1,521	0.22	0.39	0	1
Obese (lag)	1,521	0.06	0.19	0	1
Age	6,136	29.3	7.6	18	55
Married	6,136	0.61	0.39	0	1
Ethnicity Han	6,136	0.91	0.29	0	1
Medical Insurance	6,136	0.70	0.56	0	1
Coastal Region	6,136	0.33	0.37	0	1
Central Region	6,136	0.44	0.26	0	1
Other Region	6,136	0.23	0.28	0	1
Urban Hukou	6,136	0.54	0.48	0	1
Elementary School	6,136	0.15	0.28	0	1
Middle School	6,136	0.37	0.32	0	1
High School	6,136	0.33	0.21	0	1
College Education	6,136	0.15	0.29	0	1
Difficulty in running one kilometer	2,678	0.51	0.33	0	1

Source: Data from CHNS 1989-2011

2.5.2 Empirical Results

Firstly, I use OLS estimates to serve as a benchmark effect of obesity on worker wages. I consider the hypothesis that weight and wage are strongly associated after controlling for other variables. Secondly, my strategy is to replace the weight variable with its lagged value in the OLS regression. This method of accounting for reverse causality is that I assume lagged weight is uncorrelated with the current wage residual and current wage residual and lagged weight wage residual is uncorrelated. This approach removes current wage effects on body weights, but it does not account for the fact that genetic and non-genetic factors of current wage and lagged weight might be correlated. Therefore, I followed Cawley's (2004) approach and used a fixed-effects estimation. Furthermore, because the CHNS is a panel data set that covers around twenty years, it is necessary to include controls for time. Even though the fixed-effects model improves OLS method, it does not deal with unobserved factors that might affect body weight and hourly wages vary between periods of time. Consequently, I adopt an instrumental variable strategy to deal with this issue. Table 2.6 presents the regression results associated with various measures of weight based on OLS, OLS lagged weight and fixed effects (without and with time fixed effect) regressions for males. Table 2.7 shows the same results for females.

Pooled OLS regression

First, I use a pooled OLS regression with the CHNS panel data structure to estimate:

$$\mathrm{LnW}_{it} = \beta X_{it} + \varepsilon_{it} \tag{2.7}$$

Where LnW_{it} measures the natural log of hourly wage, X_{it} is a vector of independent variables including the current BMI (or other variables measuring current weight) that affect wages, and ε_{it} is the residual. With the existence of endogeneity of current body weight, the OLS coefficients are likely to be inconsistent and biased.

Results for males and females are presented in Table 2.6 and 2.7 respectively. I focus on the coefficients of the three measures of body weight: BMI, body weight in kilograms and weight indicators associated with being underweight, normal weight, overweight, or obese, where normal weight is the reference group. The complete models including all variables in the models are shown in Appendices 1 through 8.

I find in Table 2.6, for BMI and body weight in kilograms the coefficients are both significantly positive in OLS regressions. The coefficient of male workers is 0.0058 and is statistically significant, which indicates that body weight effect on the log hourly wage is positive. The weight coefficient is 0.0014 and is statistically significant, so that weight has a significantly positive correlation to log hourly wage.

Column 1 of Table 2.6 also includes the OLS coefficients on the dummy variables for indicators of clinical classifications (underweight, normal weight, overweight, and obese where normal weight is the reference group). Among male workers, the underweight coefficient is -0.0938 and is statistically significant, indicating that male workers who are underweight earn 9.38% less than male workers who are normal bodyweight. The coefficient of overweight is 0.0333 with a t value of 1.27, which means that male workers who are overweight earn 3.33% more than male workers who are normal bodyweight, while this effect is also statistically insignificant. The coefficient of obesity is 0.0560 with t value is 0.89, which means that obese male workers earn more than male workers who have normal bodyweight, and this effect is still statistically insignificant.

Table 2.7 shows the results for women and yields very different results than those just found for men. The BMI coefficient for female workers is -0.0062, indicating a negative impact on the log hourly wage. The t value is -4.15 and is statistically significant. Weight coefficient is -0.0011 and is statistically significant, so that weight has a significantly negative correlation to log hourly wage. This result indicates that females suffer a wage penalty for gaining weight. The interesting results are for the categories of overweight and obese when wages are compared to women of normal weight. The coefficient on overweight is -0.0694 and is significant at the 5% level, which means that female workers who are overweight earn 6.94% less than female workers who have a normal bodyweight. The coefficient on obese is -0.1091 and is significant at the 1% level, which means that obese female workers earn even less, 10.9%, compared to female workers who have a normal bodyweight.

From OLS estimate results, I find that male workers' BMI and body weight are positively related to individual's log hourly wage, the results indicate a positive correlation between weight and wages for males. In contrast, the BMI of a typical female worker and her body weight are negatively related to her hourly wage. Female workers are subject to a wage penalty as their body weights get higher. As for indicators for clinical classifications, underweight male workers have lower wages compared to their counterparts who have a normal weight. While the wages of underweight women are not significantly different from wages of women having a normal weight. In terms of being classified as overweight or obese, the wages of male workers are not significantly different from wages of males who have a normal weight. On the other hand, female workers who are overweight or obese suffer a significant wage penalty.

Table 2.6: Coefficients and t-Statistics from Log Wage Regressions for Males in China

	OLS	OLS (Lagged weight)	Fixed Effects	Fixed Effects (with time effect)
Column Number	1	2	3	4
BMI	0.0058***	0.0066**	0.0047**	0.0043**
	(2.55)	(2.28)	(2.11)	(1.97)
Weight	0.0014***	0.0018***	0.0013**	0.0012**
	(2.87)	(2.52)	(1.98)	(1.95)
Underweight	-0.0938*	-0.0529	0.0110	0.0009
	(-1.69)	(-1.28)	(0.63)	(0.52)
Overweight	0.0333	0.0270	0.0238	0.0211
	(1.27)	(0.88)	(1.16)	(1.03)
Obese	0.0560	0.0543	0.0449	0.0325
	(0.89)	(0.78)	(1.59)	(1.15)
Number of Observations	9,346	2,136	9,346	9,346

Notes: (1) Data: For columns 1, 3, and 4 the data are from the 1989-2011 CHNS; for column 2 the data is from the 2000, 2004, 2006 CHNS. (2) One of three measures of weight is used: BMI, weight in pounds or indicator variables for clinical weight classification: underweight, overweight, and obese (where healthy weight is the excluded category). (3) For BMI and weight in kilograms, coefficients and t-statistics are listed. For the dummy variables Underweight, Overweight, and Obese, the coefficients are an indication the effect of that category with respect to the category normal weight. (4) Other regressors include: age, age squared, indicator variables for marital status, education, ethnicity, region of residence, health insurance, and hukou status. (5) The three different asterisks and their level of significance: *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

Table 2.7: Coefficients and t-Statistics from Log Wage Regressions for Females in China

	OLS	OLS (Lagged weight)	Fixed Effects	Fixed Effects (with time effect)
Column Number	1	2	3	4
BMI	-0.0062***	-0.0073***	-0.0026	-0.0015
	(-4.15)	(-2.38)	(-1.29)	(-0.75)
Weight	-0.0011***	-0.0017**	-0.0006*	-0.0004
	(-3.62)	(-2.12)	(-1.76)	(-1.01)
Underweight	0.0235	0.0429	-0.0310	-0.0215
	(1.33)	(1.02)	(-1.63)	(-1.13)
Overweight	-0.0694**	-0.0870	-0.0538***	-0.0474**
	(-2.27)	(-1.13)	(-2.36)	(-2.08)
Obese	-0.1091***	-0.0963**	-0.0749***	-0.0591***
	(-3.89)	(-2.28)	(-3.59)	(-2.83)
Number of Observations	6,136	1,521	6,136	6,136

Notes: (1) Data: For columns 1, 3, and 4 the data are from the 1989-2011 CHNS; for column 2 the data is from the 2000, 2004, 2006 CHNS. (2) One of three measures of weight is used: BMI, weight in pounds or indicator variables for clinical weight classification: underweight, overweight, and obese (where healthy weight is the excluded category). (3)For BMI and weight in kilograms, coefficients and t-statistics are listed. For the dummy variables Underweight, Overweight, and Obese, the coefficients are an indication the effect of that category with respect to the category normal weight. (4) Other regressors include: age, age squared, indicator variables for marital status, education, ethnicity, region of residence, health insurance, and hukou status. (5) The three different asterisks and their level of significance: *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

OLS with a Lagged Weight Strategy

The weight variables and error term in equation 2.7 may be correlated if there is reverse causality or if an unobserved variable caused both heaviness and adverse labor market outcomes. My second method to correct the endogeneity problem is to follow Cawley (2004) by replacing the weight variable with the lagged value. This strategy is based on the assumption that lagged weight is uncorrelated with the current wage residual and there is no correlation in the wage residuals between periods. The CHNS survey I employ in this essay was launched in 1989 and eight more waves of panel data were conducted in 1991, 1993, 1997, 2000, 2004, 2006, 2009 and 2011 respectively. I focus on the CHNS data after year 2000 and use a 5-year time interval in the OLS lagged weight regression. That means in the 2011 data for each individual respondent, I use the weight variable from 2006; in the 2009 data for each individual respondent, I use the weight variable from 2004; and in the 2006 data for each individual respondent I use the weight variable from 2000. The last year is obviously 6-year but the CHNS data set limits the intervals. While this strategy will remove any contemporaneous effect of wages on weight, it does not deal with the problem that the genetic and non-genetic components of the lagged weight variable may be correlated with the genetic and non-genetic components of current wages.

Column 2 in Table 2.6, for males, and Table 2.7, for females presents OLS results using a measure of weight lagged, BMI lagged and weight lagged in kilograms. The BMI coefficient of male workers is 0.0066, which has a positive impact on the log hourly wage, and the effect is statistically significant at the 5% level. The weight coefficient is 0.0018 and is significant at the 1% level, indicating that weight has a significantly positive correlation to log hourly wage.

In Column 2 of Table 2.6, the underweight coefficient of male workers is -0.0529 and the t value is -1.28, indicating that male workers who are underweight earn 5.29% less than male workers who have a normal bodyweight. The overweight coefficient is 0.0270 with a t value of 0.88, which means that male workers who are overweight earn 2.7% more than male workers who are normal bodyweight. The coefficient of obesity is 0.0543 with a t value of 0.78, which means that obese male workers earn even more than male workers who have normal bodyweight. The three coefficients are all statistically insignificant.

For female workers, I find that the BMI coefficient is -0.0073, which represents a negative impact on the log hourly wage. The t value is -2.38 and is statistically significant at the 1% level. Compared to male workers, female workers are subject to wage penalty as their BMI increases. The weight coefficient is -0.0017 and is significant at the 5% level, indicating that weight has a statistically significant negative correlation to log hourly wage. The underweight coefficient is 0.0429 and the t value is 1.02, indicating that female workers who are underweight earn 4.29% more than female workers who are classified as having normal bodyweight, but this effect is statistically insignificant. The coefficient of overweight is -0.0870 with a t value of -1.13, which means that female workers who are overweight earn 8.7% less than female workers who have normal bodyweight, but this effect is also statistically insignificant. The interesting result for women is the 9.3% wage penalty for being obese. That is, obese women earn 9.3% less than women of normal weight.

The estimated OLS results shown in columns 1 and 2 of Tables 2.6 and 2.7 when using the current weight and lagged weight are very similar for males and females. For males (females) the coefficients are positive (negative). The data shows that female workers are subject to wage penalties as body weight increases. Both current body weight and lagged body weight yield statistically significant wage penalties for female workers. In contrast, the effect is fundamentally opposite for male workers, in that the effect of body weight on log hourly wage is positive with heavier male workers earning higher wages. Overweight or obese males' hourly wages are not significantly different from that of those who are of normal weight.

Fixed-Effect Strategy

I use a fixed-effects model to eliminate time-invariant heterogeneity. Previous literature took into account differences between sibling and twins (Averett and Korenman 1996; Behrman and Rosenzweig 2001). Based on the assumption that genes and non-genetic factors are constant over time, I exploit the longitudinal nature of the CHNS data to eliminate individual-specific fixed effects. Furthermore, considering that CHNS is panel data and our study covers around twenty years, it is necessary to include a time fixed effect to control for shocks in different time periods that may affect the outcome variables. I created dummy variables for each wave year with the first year the omitted group.

Results from fixed-effects (without and with time effect) regressions in Columns 3 and 4 of Tables 2.6 and 2.7. In Table 2.6, the BMI coefficient of male workers is 0.0047. The t value is 2.11 and is statistically significant at the 5% level. Male workers' wages increase as their BMI increases. These results are consistent with the coefficients from OLS with current weight and OLS with lagged weight, when the effect is positive (although smaller in magnitude) and statistically significant. The weight coefficient is 0.0013 and is significant at the 5% level, indicating that weight has a statistically significant positive correlation to log hourly wage.

As for the fixed effects model results for female workers in columns 3 and 4, I find that the BMI coefficient is -0.0026 (see Table 2.7), which has a negative impact of weight on the log hourly wage variable. The t value is -1.29 and statistically insignificant. Compared to male workers, female workers experience a wage penalty as their BMI increases. The major difference between the fixed-effects coefficients of males and females from OLS current weight and OLS lagged weight coefficients is that the estimate for males is positive and statistically significant while the estimate of females is negative and no longer statistically significant. The weight coefficient is -0.0006 and the t value is -1.76, indicating that female body weight has a coefficient that is negative and statistically significant at the 10% level.

Because of the panel nature of the CHNS data and the fact that various changes may occur over time, column 4 includes a series of time variables for each year in the sample. I created dummy variables for each wave year with the first year the omitted group. The empirical results of fixed effects with time effect are listed in Column 4 of Tables 2.6 and 2.7. For males, the BMI coefficient is 0.0043 and the t value is 1.97 and significant at the 5% level; the weight coefficient is 0.0012 and the t value is 1.95 and significant at the 5% level. As for females, the BMI coefficient is -0.0015 and the t value is -0.75; the weight coefficient is -0.0004 and the t value is -1.01. Compared to the results of fixed effect without time trends in Column 3, the magnitude of coefficients and t values are smaller while the significance of all coefficients is not changed. The coefficients of BMI and weight are positively associated with males' log hourly wages and negatively associated with females' log hourly wages. A joint-F test to test was conducted to determine whether the time variables are significant as a group in the wage equation. The F-statistics indicate that for both the males and female regressions that time variables as a group are a significant determinant of the wage.[36]

When I use the dummy variables for obese, overweight and underweight, for males and when compared to those having normal weights, there are no statistically significant differences in the wages. In contrast to the results for males, in all four models in Table 2.7, the women who were either overweight or obese earn significantly lower salaries than do women who are of normal weight. The wage penalty ranges from 4.7% in the fixed effects model with the time effect included to 8.7% in the lagged weight model. The penalty for being obese ranges from 7.4% for the fixed effects (no time effect) to 10.9% for the current wage OLS model. These are all statistically significant differences.

Instrumental Variable Strategy

The primary concern with the fixed effects approach is that the assumptions could be violated if unobservable factors vary over time. To deal with this problem, I use an instrumental variable strategy. Using the 1989-2006 waves of the CHNS, Xie and Awokuse (2013) employed "difficulty in running one kilometer" as an instrumental variable to investigate the relationship between health status and individual income to control the endogeneity problem. Inspired by their study, I use the same instrumental variable, "difficulty in running one kilometer," to analyze the effects of weight on wages.

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36 The joint-F tests associated with the hypothesis that the year dummies are jointly equal to zero was 72.4 for males and 51.6 for females respectively.

Two conditions must hold in order to be a valid instrumental variable. The first requirement is that the instrument, “difficulty in running one kilometer,” must be strongly correlated with the respondent’s BMI. Intuitively, people with a higher body weight should find it more difficult to run a long distance, which means the relationship between body weights and difficulty in running a certain long distance should be positive. Belke (1996) confirmed that the ability to run decreases as body weight increases, and that the motivation to run increases as body weight decreases. The result leads to the hypothesis that there is a strong correlation between the instrument and the BMI of the respondent. The hypothesis is supported by the first-stage regression results for both genders in Table B.9 in Appendix B, where the instrument “difficulty in running one kilometer” has a positive and statistically significant effect on respondents’ BMIs for both males and females. The F statistic[37] associated with the hypothesis that the first-stage coefficient on the instrument is equal to zero is 23.5 for males and over 27.3 for females[38], which exceeds the minimum F statistic of 10 suggested by Staiger and Stock (1994).[39]

The second requirement is that the instrument must be uncorrelated with the wage equation residual, which means whether or not the exclusion restriction is satisfied. In my application, this indicates that the instrument difficulty in running one kilometer should not directly correlate with the residual in the respondent’s wage

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37 This F-statistic is not the overall F-static, overall F-static tests whether the coefficients on the control variables equal zero.

38 The F-statistic numbers are shown in Table B.9 in Appendix B.

39 They claim that if F-statistic is less than 10, it is a weak instrument.

equation. The only circumstance under which such correlation occurs is that some unobservable factors determine both individual hourly wage and the difficulty in running one kilometer. For example, an unobserved factor like ability might have some influence on the instrument, in which people with an innate ability would have less difficulty in running one kilometer, and the unobserved factor also might affect individual hourly wage. To test whether the exclusion restriction is satisfied, I apply an OLS model to estimate the correlation between the instrument and individual log hourly wage.[40] While it is not a definitive test, if the correlation between the instrument and the wage outcome is statistically significant it would cast doubt on the instrument's validity. Table B.10 in Appendix B reports the regression results for both genders. The suggestive evidence from this test is consistent with the identifying assumption, that neither of the coefficient estimates associated with the instrument is statistically significant at the 10% level, suggesting that such direct correlation is not significant in our sample.

In summary, I find a strong correlation between the individual body weights and the instrument "difficult in running one kilometer," but I do not find evidence on the direct correlation between the instrumental variable and respondent wage residual, indicating that the instrumental variable is unlikely to be weak.

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40 Jay and Xuezheng (Jay and Xuezheng 2013b) applied a community level OLS model to estimate the correlation between the community BMI prevalence (instrument) and the employment percentage to check the second requirement (instrument should not be correlated with individual employment) of the validity of the instrument in their paper about how body size impacts urban employment in China.

Instrumental variable coefficients on BMI and weight in kilograms are presented in Column 1 and 2 of Tables 2.8 and 2.9 for males and females respectively. Column 1 in each of the Tables presents, for the sake of comparison, OLS coefficients estimated using the IV sample. I did not use the method of IV to estimate coefficients on the indicators for the clinical classifications because the order condition is not satisfied when there are three endogenous variables (the indicators for underweight, overweight, and obesity) and one instrument (difficulty in running one kilometer).

Table 2.8 indicates that for males the IV coefficients are positive and the effect is statistically significant. The point estimate of that IV coefficient is roughly 40 percent higher than the OLS coefficient estimated by using the same IV sample. Table 2.9 indicates that for females the IV coefficients are negative while the effect is statistically insignificant. The point estimate of that IV coefficient is roughly 60 percent lower than the OLS coefficient estimated by using the same IV sample. So far, instrumental variable results indicate that the hypothesis that body weight does not lower wages can be rejected only for male workers and heavier male workers earn more is robust. For all cases, a Hausman test[41] fails to reject the hypothesis that OLS and IV coefficients are equal for both males and females. Therefore, any endogeneity of weight does not appreciably affect the OLS estimates and OLS should be preferred to IV since OLS results in lower standard errors.

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41 The Hausman test compares the OLS estimator and the IV estimator. The null hypothesis is that the OLS estimator is equal to the IV estimator. This test may show that my use of the IV estimator has significantly affected the point estimate of the effect of the control variables. If I cannot reject the null, the OLS is as good as the IV strategy.

Table 2.8: IV Coefficients and t-statistics from Log Wage Regressions for Males

	OLS using IV sample	IV
BMI	0.0076**	0.0109***
	(2.13)	(2.38)
		F = 23.5
Weight	0.0018***	0.0026**
	(2.45)	(2.16)
		F = 21.9
Number of Observations	4,369	4,369

Notes: (1) Data: CHNS 1989-2011 and OLS regression used the IV sample which is smaller than the OLS sample. (2) One of two measures of weight is used: BMI or weight in kilograms. (3) Coefficients and t-statistics are listed. (4) Other regressors include: age, age squared, indicator variables for marital status, education, ethnicity, region of residence, health insurance, and hukou status. (5) Column 2 also lists the F-test associated with the test of the hypothesis that the coefficient on the instrument is equal to zero. (6) The three different asterisks and their level of significance: *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

Table 2.9: IV Coefficients and t-statistics from Log Wage Regressions for Females

	OLS using IV sample	IV
BMI	-0.0083***	-0.0136
	(-3.29)	(-1.35)
		F = 27.3
Weight	-0.0021***	-0.0035
	(-2.93)	(-1.59)
		F = 26.5
Number of Observations	2,678	2,678

Notes: (1) Data: CHNS 1989-2011 and OLS regression used the IV sample which is smaller than the OLS sample. (2) One of two measures of weight is used: BMI or weight in kilograms. (3) Coefficients and t-statistics are listed. (4) Other regressors include: age, age squared, indicator variables for marital status, education, ethnicity, region of residence, health insurance, and hukou status. (5) Column 2 also lists the F-statistics associated with the test of the hypothesis that the coefficient on the instrument is equal to zero. (6) The three different asterisks and their level of significance: *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

2.6 Conclusion

In this essay, my objective has been to identify the causal effect of body weight on individual hourly wages between genders in China by using the data from China Health and Nutrition Survey (CHNS). This study improves the literature in two ways. First, I investigate the impact of body weight on individual hourly wages using the latest CHNS data (through 2011). Second, I adopt an instrumental variable approach to account for the endogeneity problem by using a unique instrumental variable.

First, I use OLS estimates and find that male workers' BMI and body weight are positively related to individual's log hourly wage. In contrast, body weight is negatively related to hourly wage of females. Female workers are subject to a wage penalty for being overweight or obese. Underweight male workers have lower wages compared to their counterparts who have a normal weight. Again and different from males, the wages of underweight women are not significantly different from wages of women having a normal weight. The wages of overweight or obese men are not significantly different from wages of their counterparts who have a normal weight. Females, on the other hand, who are overweight or obese suffer a significant wage penalty.

Second, I replace the weight variable with its lagged value in the OLS regression. The estimated OLS results of lagged weight are very similar with that when using current weight for males and females. For males (females) the coefficients are positive (negative). Both current body weight and lagged body weight yield statistically significant wage penalties for female workers. The effect is fundamentally opposite for male workers, in that the effect of body weight on log of the hourly wage is positive with heavier male workers earning higher wages. The salaries of overweight and obese males are not significantly different from salaries of those who are of normal weight.

Then I employed a fixed effects model. The BMI coefficient of male workers is 0.0047 and the weight coefficient is 0.0013, both are significant at the 5% level. For female workers, the BMI coefficient is -0.0026, which has a negative and statistically insignificant impact of weight on the log hourly wage. The major difference between the fixed-effects and OLS coefficients for males and females is that the current weight and OLS lagged weight coefficients for males are positive and statistically significant while for females they are negative but no longer statistically significant. I also include a time fixed effect. For males, the BMI coefficient is 0.0043 and the weight coefficient is 0.0012, both are significant at the 5% level. For females, the BMI coefficient is -0.0015 and the weight coefficient is -0.0004, both are statistically insignificant. Compared to the results of fixed effect without time trends, the magnitude of coefficients and t values are smaller while the significance of all coefficients is not changed.

Finally I use an instrumental variable strategy to deal with unobservable factors that may vary over time. I find a strong correlation between the individual body weights and the instrument "difficulty in running one kilometer," but I do not find evidence on the direct correlation between the instrumental variable and respondent wage residual, indicating that the instrumental variable is reliable. The IV coefficients for males are positive and the effect is statistically significant. The point estimate of that IV coefficient is roughly 40 percent higher than the OLS coefficient estimated by using the same IV sample. For females, the IV coefficients are negative while the effect is statistically insignificant. The point estimate of that IV coefficient is roughly 60 percent lower than the OLS coefficient estimated by using the same IV sample. For all cases, a Hausman test fails to reject the hypothesis that OLS and IV coefficients are equal for both males and females. Therefore, any endogeneity of weight does not appreciably affect the OLS estimates and OLS should be preferred to IV since OLS results in lower standard errors.

Overall, I find positive effect of body weight on individual's hourly wage for male workers in China. This is consistent with the results for low-income developing countries (Thomas and Strauss 1997, 159-185). As for females, I find that body weight is negatively related to hourly wages in China. The result is similar to that of previous literature (Shimokawa 2008; Luo and Zhang 2012). For future research, it is necessary to investigate how body weight affects individual wages by using the new CHNS data. And it would be interesting to analyze whether the effects of weight on wages are the same throughout the distribution of wages by quantile regression. Comparing to Cawley's (2004) study, which is based on the U.S. labor market, he found that weight lowers wages for white females and heavier black males tend to earn more. My empirical results are consistent with that of his study for typical sub ethic-gender group. Further explanations for differences between genders and countries (especially between developed and developing countries) in the correlation between body weight and wages is also recommended.

Chapter 3

CONCLUDING SUMMARY

My research includes two essays on Chinese labor markets. In first essay, I examine how minimum wage increase impacted on employment in China in 2011 and 2012, using data from China General Social Survey (CGSS). This essay fills the gap to the existing literature mainly in three aspects. First, this essay provides the latest evidence of existing literature. Second, this is the first essay to use Difference-in-difference-in-difference (DIDID) in China minimum wage study. Last, the Synthetic Control Method is firstly employed. For two risk groups: age 16-19 teens not in college and age 20-59 adults not high school education, which are proved to be easily affected by minimum wage increase. I find that minimum wage increase has a small and statistically insignificant negative employment effect for two risk groups. In Eastern China, minimum wage increase has insignificantly adverse effect on both groups. But in Central and Western China, minimum wage increase positively promote job opportunities. In terms of ranges of minimum wage increasing, if minimum wage increase is less than 15%, teens and less-educated adults would be benefit from the minimum wage increase, however, if minimum wage increase even further, enterprises would provide less job offers to both groups.

In second essay, I present estimates of the effect of body weight on hourly wages in China by using the data from China Health and Nutrition Survey (CHNS). This study improves the literature in two ways. First, I investigate the impact of body weight on individual hourly wages using the latest CHNS data (through 2011).

Second, I adopt an instrumental variable approach to account for the endogeneity problem by using a unique instrumental variable. Several regression strategies were employed to obtain the wage effects of weight. I find significantly positive effect of body weight on individual's hourly wage for male workers in China. This is consistent with the results for low-income developing countries. As for females, I find that body weight is negatively related to hourly wages in China. Female workers suffer from wage penalty as their body weight getting higher.

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Appendix A

ADDITIONAL RESULTS FOR CHAPTER 1

Table A.1: Effects of Minimum Wage Increases on Employment Rate of at-risk Group in Eastern China, 2011-2012

	Age 16-19 (not in College)	Age 20-59 (< HS education)	Male Age 30-59 (at least some College)
Treatment Group			
2011			
Employment Rate	0.4961	0.6857	0.8932
Standard Deviation	0.0155	0.0112	0.0124
N.	1,038	1,732	618
2012			
Employment Rate	0.4868	0.6874	0.9045
Standard Deviation	0.0156	0.0112	0.0119
N.	1,021	1,702	612
Difference	-0.0093	0.0017	0.0113
t-statistic	0.42	0.11	0.66
Control Group			
2011			
Employment Rate	0.4712	0.6681	0.9075
Standard Deviation	0.0264	0.0194	0.0186
N.	358	589	242
2012			
Employment Rate	0.4795	0.6802	0.9104
Standard Deviation	0.0266	0.0194	0.0186
N.	352	576	237
Difference	0.0083	0.0121	0.0029
t-statistic	0.22	0.44	0.11
DID_B (T-C)	-0.0176	-0.0104	0.0084
t-statistic	0.40	0.33	0.27
DID_W (T-C)	-0.0206	-0.0096	
t-statistic	0.74	0.41	
DIDID	-0.026	-0.0188	
t-statistic	0.48	0.42	

Source: CGSS

Table A.2: Effects of Minimum Wage Increases on Employment Rate of at-risk Group in Central China, 2011-2012

	Age 16-19 (not in College)	Age 20-59 (< HS education)	Male Age 30-59 (at least some College)
Treatment Group			
2011			
Employment Rate	0.4437	0.6421	0.8863
Standard Deviation	0.0219	0.0160	0.0161
N.	516	895	389
2012			
Employment Rate	0.4615	0.6583	0.8904
Standard Deviation	0.0221	0.0159	0.0160
N.	507	885	381
Difference	0.0178	0.0162	0.0041
t-statistic	0.57	0.72	0.18
Control Group			
2011			
Employment Rate	0.4218	0.6254	0.8721
Standard Deviation	0.0301	0.0209	0.0217
N.	270	538	236
2012			
Employment Rate	0.4375	0.6405	0.8808
Standard Deviation	0.0305	0.0210	0.0214
N.	265	523	230
Difference	0.0157	0.0151	0.0087
t-statistic	0.37	0.51	0.29
DID_B (T-C)	0.0021	0.0011	-0.0046
t-statistic	0.04	0.03	0.12
DID_W (T-C)	0.0137	0.0121	
t-statistic	0.36	0.38	
DIDID	0.0067	0.0057	
t-statistic	0.10	0.11	

Source: CGSS

Table A.3: Effects of Minimum Wage Increases on Employment Rate of at-risk Group in Western China, 2011-2012

	Age 16-19 (not in College)	Age 20-59 (< HS education)	Male Age 30-59 (at least some College)
Treatment Group			
2011			
Employment Rate	0.4304	0.6171	0.8747
Standard Deviation	0.0200	0.0144	0.0142
N.	614	1,132	542
2012			
Employment Rate	0.4566	0.6352	0.8817
Standard Deviation	0.0203	0.0144	0.0139
N.	601	1,111	539
Difference	0.0262	0.0181	0.0070
t-statistic	0.92	0.89	0.35
Control Group			
2011			
Employment Rate	0.4099	0.6011	0.8614
Standard Deviation	0.0417	0.0401	0.0368
N.	139	149	88
2012			
Employment Rate	0.4241	0.6156	0.8662
Standard Deviation	0.0422	0.0446	0.0369
N.	137	119	85
Difference	0.0142	0.0145	0.0048
t-statistic	0.24	0.24	0.09
DID_B (T-C)	0.0120	0.0036	0.0022
t-statistic	0.18	0.06	0.04
DID_W (T-C)	0.0192	0.0111	
t-statistic	0.55	0.39	
DIDID	0.0098	0.0014	
t-statistic	0.11	0.02	

Source: CGSS

Table A.4: Effects of Minimum Wage Increases on Employment Rate of at-risk Group for 0-15% increase in China, 2011-2012

	Age 16-19 (not in College)	Age 20-59 (< HS education)	Male Age 30-59 (at least some College)
Treatment Group			
2011			
Employment Rate	0.4707	0.6587	0.8891
Standard Deviation	0.0164	0.0118	0.0126
N.	921	1,621	623
2012			
Employment Rate	0.4895	0.6752	0.8953
Standard Deviation	0.0166	0.0118	0.0123
N.	909	1,588	617
Difference	0.0188	0.0165	0.0062
t-statistic	0.80	0.99	0.35
Control Group			
2011			
Employment Rate	0.4323	0.6313	0.8826
Standard Deviation	0.0179	0.0135	0.0135
N.	767	1,276	566
2012			
Employment Rate	0.4446	0.6454	0.8874
Standard Deviation	0.0181	0.0137	0.0135
N.	755	1,218	552
Difference	0.0123	0.0141	0.0048
t-statistic	0.48	0.73	0.25
DID_B (T-C)	0.0065	0.0024	0.0014
t-statistic	0.19	0.09	0.05
DID_W (T-C)	0.0126	0.0103	
t-statistic	0.43	0.43	
DIDID	0.0051	0.0010	
t-statistic	0.12	0.03	

Source: CGSS

Table A.5: Effects of Minimum Wage Increases on Employment Rate of at-risk Group for 15-25% increase in China, 2011-2012

	Age 16-19 (not in College)	Age 20-59 (< HS education)	Male Age 30-59 (at least some College)
Treatment Group			
2011			
Employment Rate	0.4525	0.6434	0.8815
Standard Deviation	0.0170	0.0129	0.0132
N.	856	1,370	598
2012			
Employment Rate	0.4622	0.6562	0.8873
Standard Deviation	0.0172	0.0129	0.0130
N.	843	1,355	592
Difference	0.0097	0.0128	0.0058
t-statistic	0.40	0.70	0.31
Control Group			
2011			
Employment Rate	0.4323	0.6313	0.8826
Standard Deviation	0.0179	0.0135	0.0135
N.	767	1,276	566
2012			
Employment Rate	0.4446	0.6454	0.8874
Standard Deviation	0.0181	0.0137	0.0135
N.	755	1,218	552
Difference	0.0123	0.0141	0.0048
t-statistic	0.48	0.73	0.25
DID_B (T-C)	-0.0026	-0.0013	0.0010
t-statistic	0.07	0.05	0.04
DID_W (T-C)	0.0039	0.0070	
t-statistic	0.13	0.27	
DIDID	-0.0036	-0.0023	
t-statistic	0.08	0.06	

Source: CGSS

Table A.6: Effects of Minimum Wage Increases on Employment Rate of at-risk Group for above 25% increase in China, 2011-2012

	Teens 16-19 (not in College)	Age 20-59 (< HS education)	Male Age 30-59 (at least some College)
Treatment Group			
2011			
Employment Rate	0.4436	0.6294	0.8817
Standard Deviation	0.0251	0.0174	0.0178
N.	391	768	328
2012			
Employment Rate	0.4491	0.6265	0.8961
Standard Deviation	0.0256	0.0176	0.0170
N.	377	755	323
Difference	0.0055	-0.0029	0.0144
t-statistic	0.15	0.12	0.58
Control Group			
2011			
Employment Rate	0.4323	0.6313	0.8826
Standard Deviation	0.0179	0.0135	0.0135
N.	767	1,276	566
2012			
Employment Rate	0.4446	0.6454	0.8874
Standard Deviation	0.0181	0.0137	0.0135
N.	755	1,218	522
Difference	0.0123	0.0141	0.0048
t-statistic	0.48	0.73	0.25
DID_B (T-C)	-0.0068	-0.017	0.0096
t-statistic	0.15	0.54	0.31
DID_W (T-C)	-0.0089	-0.0173	
t-statistic	0.20	0.50	
DIDID	-0.0164	-0.0266	
t-statistic	0.30	0.60	

Source: CGSS

Appendix B

ADDITIONAL RESULTS FOR CHAPTER 2

Table B.1: Coefficients and t-Statistics for Males from 1989 to 2011 in China –OLS

	OLS Regression		
Column Number	1	2	3
BMI	0.0058***		
	(2.55)		
Weight		0.0014***	
		(2.87)	
Underweight			-0.0938*
			(-1.69)
Overweight			0.0333
			(1.27)
Obese			0.0560
			(0.89)
Age	0.0604**	0.0595**	0.0579**
	(2.16)	(2.13)	(2.02)
Age*Age	-0.0001***	-0.0001***	-0.0001***
	(-3.52)	(-3.52)	(-3.48)
Married	0.1502*	0.1386*	0.1534*
	(1.84)	(1.76)	(1.87)
Middle School	0.2659***	0.2586***	0.2603***
	(5.40)	(5.24)	(5.26)
High School	0.4514***	0.4301***	0.4338***
	(6.62)	(6.42)	(6.47)
College Education	0.6235***	0.5918***	0.6187***
	(7.36)	(7.04)	(7.33)
Ethnicity Han	0.1212	0.1132	0.1228
	(0.99)	(0.92)	(1.00)
Central Region	-0.1603*	-0.1836*	-0.1477
	(-1.68)	(-1.90)	(-1.56)
Rest Region	-0.3287***	-0.3359***	-0.3168***
	(-3.42)	(-3.50)	(-3.31)
Medical Insurance	0.1171*	0.1184*	0.1085
	(1.75)	(1.77)	(1.62)
Urban Hukou	0.1875***	0.2014***	0.1837***
	(2.91)	(3.11)	(2.87)
N	9,346	9,346	9,346
F-Statistics	81.85	82.13	89.49
R-Squared	0.231	0.253	0.247

Notes: CHNS Survey 1989-2011.The three different asterisks and their level of significance: *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

Table B.2: Coefficients and t-Statistics for Males from 2000 to 2011 in China –OLS Lagged

	OLS With Lagged Weight		
Column Number	1	2	3
BMI (lag)	0.0066***		
	(2.28)		
Weight (lag)		0.0018***	
		(2.52)	
Underweight (lag)			-0.0529
			(-1.28)
Overweight (lag)			0.0270
			(0.88)
Obese (lag)			0.0543
			(0.78)
Age	0.0838***	0.0843***	0.0818***
	(2.48)	(2.49)	(2.48)
Age*Age	-0.0001***	-0.0001***	-0.0001***
	(-3.13)	(-3.13)	(-3.13)
Married	0.2013	0.1976	0.1963
	(1.45)	(1.43)	(1.42)
Middle School	0.3189***	0.3279***	0.3047***
	(3.29)	(3.31)	(3.17)
High School	0.4879***	0.4765***	0.4751***
	(5.78)	(5.75)	(5.75)
College Education	0.6131***	0.6218***	0.6191***
	(6.85)	(6.87)	(6.85)
Ethnicity Han	0.1431	0.1398	0.1382
	(1.12)	(1.11)	(1.11)
Central Region	-0.1853**	-0.1819**	-0.1902**
	(-2.12)	(-2.11)	(-2.14)
Rest Region	-0.3578***	-0.3631***	-0.3623***
	(-2.33)	(-2.34)	(-2.34)
Medical Insurance	0.0956**	0.0983**	0.0917*
	(1.96)	(1.98)	(1.94)
Urban Hukou	0.1838***	0.1845***	0.1953***
	(3.13)	(3.14)	(3.17)
N	2,316	2,316	2,316
F-Statistics	38.68	39.47	37.48
R-Squared	0.263	0.235	0.269

Notes: CHNS Survey 2000-2011; each individual in 2011, 2009, and 2006 was replaced by the same individual's observation in 2006, 2004, and 2000 accordingly.

Table B.3: Coefficients and t-Statistics for Males from 1989 to 2011 in China –Fixed Effects

	Fixed Effect		
Column Number	1	2	3
BMI	0.0017**		
	(2.11)		
Weight		0.0013**	
		(1.98)	
Underweight			0.0110
			(0.63)
Overweight			0.0238
			(1.16)
Obese			0.0449
			(1.59)
Age	0.0531***	0.0556***	0.0518***
	(3.07)	(3.08)	(3.06)
Age*Age	-0.0001***	-0.0001***	-0.0001***
	(3.85)	(3.85)	(3.85)
Married	0.1473	0.1449	0.1463
	(1.08)	(1.07)	(1.07)
Middle School	0.2785***	0.2861***	0.2859***
	(4.31)	(4.32)	(4.32)
High School	0.3865***	0.3798***	0.3751***
	(6.37)	(6.38)	(6.37)
College Education	0.5548***	0.5631***	0.5591***
	(8.09)	(8.11)	(8.10)
Ethnicity Han	0.1064	0.1013	0.1082
	(1.22)	(1.21)	(1.22)
Central Region	-0.1674***	-0.1649***	-0.1702***
	(2.52)	(2.51)	(2.53)
Rest Region	-0.3386***	-0.3165***	-0.3323***
	(3.05)	(2.97)	(3.03)
Medical Insurance	0.0857**	0.0921**	0.0917**
	(2.23)	(2.25)	(2.25)
Urban Hukou	0.1685*	0.1739*	0.1753*
	(1.89)	(1.91)	(1.92)
N	9,346	9,346	9,346
F-Statistics	58.75	59.36	61.52
R-Squared	0.123	0.139	0.156

Notes: CHNS Survey 1989-2011. t-statistics in parentheses

Table B.4: Coefficients and t-Statistics for Males from 1989 to 2011 in China – Time F.E.

	Fixed Effect		
Column Number	1	2	3
BMI	0.0014**		
	(1.97)		
Weight		0.0012**	
		(1.95)	
Underweight			0.0009
			(0.52)
Overweight			0.0211
			(1.03)
Obese			0.0325
			(1.15)
Age	0.0329*	0.0337*	0.0321*
	(1.90)	(1.86)	(1.89)
Age*Age	-0.0001***	-0.0001***	-0.0001***
	(3.85)	(3.85)	(3.85)
Married	0.0876	0.0912	0.0971
	(0.64)	(0.67)	(0.71)
Middle School	0.1839***	0.1942***	0.1853***
	(2.84)	(2.93)	(2.79)
High School	0.2577***	0.2641***	0.2695***
	(4.24)	(4.43)	(4.57)
College Education	0.4293***	0.4356***	0.4249***
	(6.25)	(6.27)	(6.15)
Ethnicity Han	0.0752	0.0793	0.0769
	(0.86)	(0.94)	(0.86)
Central Region	-0.1167*	-0.1223*	-0.1265*
	(-1.75)	(-1.86)	(-1.88)
Rest Region	-0.2679***	-0.2588***	-0.2614***
	(-2.40)	(-2.42)	(-2.38)
Medical Insurance	0.0974***	0.1053***	0.1009***
	(2.53)	(2.57)	(2.47)
Urban Hukou	0.2169***	0.2021**	0.2108**
	(2.43)	(2.22)	(2.31)
N	9,346	9,346	9,346
F-Statistics	71.59	73.45	72.98
R-Squared	0.158	0.169	0.147

Notes: CHNS Survey 1989-2011. The three different asterisks and their level of significance: *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

Table B.5: Coefficients and t-Statistics for Females from 1989 to 2011 in China – OLS

Column Number	1	2	3
BMI	-0.0062***		
	(-4.15)		
Weight		-0.0011***	
		(-3.62)	
Underweight			0.0235
			(1.33)
Overweight			-0.0694**
			(-2.27)
Obese			-0.1091***
			(-3.89)
Age	0.0289	0.0284	0.0276
	(0.79)	(0.78)	(0.75)
Age*Age	-0.0005	-0.0005	-0.0005
	(-1.34)	(-1.34)	(-1.27)
Married	-0.0909*	-0.0954*	-0.1086*
	(-1.82)	(-1.85)	(-1.86)
Middle School	0.2468	0.2490	0.2451
	(1.55)	(1.55)	(1.55)
High School	0.1614	0.1606	0.1508
	(0.92)	(0.91)	(0.86)
College Education	0.5786***	0.5768***	0.5758***
	(4.98)	(4.94)	(4.93)
Ethnicity Han	0.2905	0.2920	0.2535
	(1.08)	(1.09)	(0.95)
Central Region	-0.0092	-0.0128	-0.0312
	(-0.05)	(-0.07)	(-0.18)
Rest Region	-0.2063	-0.2062	-0.2462
	(-1.21)	(-1.21)	(-1.42)
Medical Insurance	0.0137	0.0122	0.0061
	(0.25)	(0.22)	(0.11)
Urban Hukou	0.1903*	0.1885*	0.2174**
	(1.82)	(1.80)	(2.06)
N	6,136	6,136	6,136
F-Statistics	59.31	58.25	59.83
R-Squared	0.229	0.253	0.239

Notes: CHNS Survey 1989-2011. The three different asterisks and their level of significance: *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

Table B.6: Coefficients and t-Statistics for Females from 2000 to 2011 in China –OLS Lagged

	OLS with Lag Weight		
Column Number	1	2	3
BMI (lag)	-0.0073***		
	(-2.38)		
Weight (lag)		-0.0017**	
		(-2.12)	
Underweight (lag)			0.0429
			(1.02)
Overweight (lag)			-0.0870
			(-1.13)
Obese (lag)			-0.0963**
			(-2.28)
Age	0.0475	0.0481	0.0432
	(1.48)	(1.49)	(1.47)
Age^2	-0.0005*	-0.0005*	-0.0005*
	(-1.67)	(-1.67)	(-1.67)
Married	-0.0783***	-0.0795***	-0.0810***
	(-2.39)	(-2.40)	(-2.41)
Middle School	0.2198**	0.2204**	0.2210**
	(2.01)	(2.01)	(2.02)
High School	0.2020*	0.2109*	0.2117*
	(1.79)	(1.79)	(1.80)
College Education	0.6388***	0.6421***	0.6287***
	(5.31)	(5.32)	(5.29)
Ethnicity Han	0.2534	0.2612	0.2124
	(1.55)	(1.56)	(1.47)
Central Region	-0.0133	-0.0153	-0.0285
	(-0.58)	(-0.63)	(-1.05)
Rest Region	-0.2338	-0.2361	-0.2545*
	(-1.58)	(-1.58)	(-1.64)
Medical Insurance	0.0198	0.0211	0.0132
	(0.48)	(0.49)	(0.39)
Urban Hukou	0.1834**	0.1799**	0.2212**
	(1.97)	(1.96)	(2.01)
N	1,521	1,521	1,521
F-Statistics	45.88	46.72	46.98
R-Squared	0.286	0.269	0.271

Notes: CHNS Survey 2000-2011.

Table B.7: Coefficients and t-Statistics for Females from 1989 to 2011 in China – Fixed Effect

	Fixed Effect		
Column Number	1	2	3
BMI	-0.0026		
	(-1.29)		
Weight		-0.0006*	
		(-1.76)	
Underweight			-0.0310
			(-1.63)
Overweight			-0.0538***
			(-2.36)
Obese			-0.0749***
			(-3.59)
Age	0.0285*	0.0273*	0.0242*
	(1.79)	(1.78)	(1.71)
Age*Age	-0.0011***	-0.0011***	-0.0011***
	(-2.81)	(-2.81)	(-2.81)
Married	-0.0579	-0.0512	-0.0586
	(-1.49)	(-1.49)	(-1.49)
Middle School	0.2088***	0.2153***	0.2010***
	(2.96)	(2.97)	(2.96)
High School	0.1793***	0.1732***	0.1617***
	(2.51)	(2.50)	(2.42)
College Education	0.5251***	0.5347***	0.5518***
	(4.83)	(4.88)	(5.03)
Ethnicity Han	0.2238	0.2312	0.2224
	(0.59)	(0.61)	(0.59)
Central Region	-0.0289	-0.0332	-0.0335
	(-1.43)	(-1.45)	(-1.45)
Rest Region	-0.2508**	-0.2597**	-0.2445**
	(-2.23)	(-2.24)	(-2.23)
Medical Insurance	0.0398	0.4032	0.0368
	(1.31)	(1.31)	(1.12)
Urban Hukou	0.1647*	0.1593*	0.1712**
	(1.91)	(1.89)	(1.99)
N	6,136	6,136	6,136
F-Statistics	49.78	49.21	48.85
R-Squared	0.101	0.118	0.097

Notes: CHNS Survey 1989-2011. t-statistics in parentheses.

Table B.8: Coefficients and t-Statistics for Females from 1989 to 2011 in China – Time F.E.

	Fixed Effect		
Column Number	1	2	3
BMI	-0.0015		
	(-0.75)		
Weight		-0.0004	
		(-1.01)	
Underweight			-0.0215
			(-1.13)
Overweight			-0.0474**
			(-2.08)
Obese			-0.0591***
			(-2.83)
Age	0.0163	0.0175	0.0172
	(1.02)	(1.14)	(1.21)
Age*Age	-0.0009**	-0.0010***	-0.0009**
	(-2.29)	(-2.55)	(-2.29)
Married	-0.0768**	-0.0811***	-0.0853**
	(-1.97)	(-2.36)	(-2.16)
Middle School	0.1672***	0.1788***	0.1719***
	(2.37)	(2.46)	(2.53)
High School	0.2854***	0.2739***	0.2631***
	(3.99)	(3.95)	(3.93)
College Education	0.4735***	0.4592***	0.4581***
	(4.35)	(4.19)	(4.17)
Ethnicity Han	0.1752	0.1631	0.1848
	(0.46)	(0.43)	(0.49)
Central Region	-0.0403**	-0.0497**	-0.0515**
	(-1.99)	(-2.17)	(-2.22)
Rest Region	-0.3043***	-0.3165***	-0.2989***
	(-2.70)	(-2.72)	(-2.72)
Medical Insurance	0.0246	0.0338	0.0306
	(0.81)	(0.92)	(0.93)
Urban Hukou	0.1854**	0.1788**	0.1931**
	(2.15)	(2.12)	(2.24)
N	6,136	6,136	6,136
F-Statistics	59.21	54.98	58.33
R-Squared	0.148	0.156	0.153

Notes: CHNS Survey 1989-2011

Table B.9: First Stage Results for Males and Females (Dependent variable is BMI)

	BMI	
	Males	Females
Difficulty in running one kilometer	0.1236***	0.1539***
	(4.85)	(5.23)
Age	0.0587	0.0947
	(1.53)	(1.39)
Age*Age	-0.0001***	-0.0001**
	(-2.81)	(-1.98)
Married	0.0361	-0.0689
	(0.78)	(-1.03)
Middle School	0.0173	0.0476
	(0.49)	(0.78)
High School	0.1254***	0.1367*
	(2.58)	(1.69)
College Education	0.1648***	0.1978**
	(3.19)	(2.12)
Ethnicity Han	0.0678	0.0382
	(1.58)	(0.95)
Central Region	-0.0589	-0.0438
	(-0.49)	(1.49)
Rest Region	-0.1378	-0.7678
	(-1.27)	(-1.41)
Medical Insurance	0.1783	0.1137
	(0.98)	(0.66)
Urban Hukou	0.1067	0.0890
	(0.79)	(1.19)
N	4,369	2,678
F-Statistics	23.5	27.3
R-Squared	0.084	0.073

Notes: CHNS Survey 1989-2011. t-statistics in parentheses. The three different asterisks and their level of significance: *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

Table B.10: Relationship Between Difficulty in Running One Kilometer and Log Hourly Wage

	Dependent Variable is Log Hourly Wage	
	Males	Females
Difficulty in running one kilometer	0.0933	-0.0741
	(0.98)	(-1.32)
Age	0.0495	0.0309
	(1.35)	(1.53)
Age*Age	-0.0002**	-0.0003***
	(-2.19)	(-3.07)
Married	0.0651*	-0.0545
	(1.87)	(-0.66)
Middle School	0.1674**	0.1362
	(2.31)	(1.21)
High School	0.2378***	0.1864*
	(2.89)	(1.93)
College Education	0.3631***	0.2298**
	(3.43)	(2.11)
Ethnicity Han	0.0547	0.0832
	(0.68)	(0.51)
Central Region	-0.1247	-0.0649
	(-1.58)	(-0.87)
Rest Region	-0.2378	-0.1375
	(-0.53)	(-1.27)
Medical Insurance	0.0641*	0.0832
	(1.79)	(1.61)
Urban Hukou	0.1178**	0.0838
	(2.15)	(1.01)
N	4,369	2,678
R-Squared	0.237	0.196

Notes: CHNS Survey 1989-2011. t-statistics in parentheses. The three different asterisks and their level of significance: *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.