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# Gender Difference of Pension Benefits in Urban China

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# Gender Difference of Pension Benefits in Urban China

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by

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## Abstract

China is becoming an ageing society. The social security system in urban China aims to protect the standard living of the elderly. However, the actuarial model predicts that the gender gap in pension benefits will tend to enlarge over the coming decades. This means that the female retirees are at a disadvantage in the distribution of pension benefits, compared with the male retirees. Using a regression analysis, I have studied the effect of factors on the pension gender gap. Besides gender discrimination, the other factors such as different retirement age, earnings, and education also have notable influences on gender differences in pension benefits. The results of this study suggest that the later Chinese pension reform should take account of the gender gap in pension benefits when proposing and implementing the new pension policies.



Key words: gender difference, pension benefits, ageing, effect factors, urban China, actuarial model, regression analysis.

# PART I INTRODUCTION

Many Chinese people believe that the social security is essentially neutral in terms of gender because it allows all people to benefit. In fact, this is not the case. The gender issue of the pension system for the old-age in China includes two facets. One refers to the pension benefits of male and female retirees. The other is the different mandatory retirement ages for men and women, and their employment rights in the labor market. The current China's social security system not only reflects the existing gender inequality in the labor market, but in some cases it also deepens the gender inequality. The gap of pension benefits between male and female retirees is basically considered attributed to the pension policies and institutional arrangements (Dong and Zhang, 2008). According to the Chinese government regulations, women working for companies or government institutions retire at the age of 55, and blue-collar female workers quit work at the age of 50, while the retirement age at present is 60 for all the male workers. Compared with other countries in the world, the mandatory retirement ages are much earlier in China. And China has the biggest gap of retirement ages between male and female employees.

## 1.1 Research Motivation

Gender difference in pension benefits is prevalent in the world. There is a big difference in pension distribution between men and women in different countries because of various national conditions, pension insurance system, labor market policies, etc. British scholars believe that the gender difference of pension distribution in the UK is mainly reflected in the different amounts of pension recipients between men and women. The American researchers analyzed the gender difference in the process of pension accumulation in the U.S. As to Latin American countries, Argentina and Chili were chosen as the typical representatives in Bertranou (2000)'s study. He deems that the gender gaps in pension coverage and benefits have been one of the policy issues missing in the pension reforms.

In recent years, the issue of gender difference in China's pension system has been drawing a lot of attention. The Chinese academic community reaches a consensus that women have a lower pension replacement rate, compared with men. Before 1997, China had implemented a so-called "traditional old-age insurance system" for nearly 50 years. This scheme prescribed that pension payments were highly correlated with wage levels and employment period (or seniority). Under

this “traditional pension system”, the mandatory different retirement ages and the length of working service were the major causes that resulted in the gender gap of pension payment. In 1997 and 2005, the Chinese government had conducted two pension reforms, respectively. Whether these reforms have narrowed the gender pensions gap in China is a crucial empirical question. And it is interesting to know whether and how the pension reforms have influenced the gender difference in pension benefits.

### 1.2 Literature Review

Gender-difference is brought forward by Stern in 1900, which is a distinction of biological or physiological characteristics associated with either males or females of a species in general. A lot of western academic literature has been dedicated to the issue of gender difference in pensions. Even and McPherson (1999) explained the causes of gender difference in pension coverage for both the retirees and the employees. They argued that much of the gender gap in pension coverage is accounted for the different physical characteristics of men and women in the labor market. Children and marriage have a negative effect on the pension coverage of female retirees, but the negative effect was not observed among the group of female employees. The case study of Wilson and Hardy (2002) showed how American women’s family and employment choices of females are linked to the differences in financial security as they age. The findings indicated that, although marriage offers women considerable financial protection, their own employment was also a key to their income security. However, the income security decayed when females entered old age. Hantrais (2002) demonstrated how socio-demographic have changed and how ensuring social problems have been experienced in central and east European countries. The author analyzed the policy responses of government and explored the problem of gender inequality in the context of enlargement for EU members and the applicant countries. Fultz’s (2004) pointed out a number of matters that merit a greater attention to gender equality and social security. He also illustrated the need for broader-based action on gender issues that influence the effects of social security schemes. Charlotte and Agnate (2005) examined different ways of pension system design in China, France, Ghana, Jordan, Mexico, Poland and Sweden with particular reference to gender differences. Women usually have a lower participation rate in the formal labor market than men along with lower wages in general.

Recently, Chinese researchers have studied the issue of gender difference in social security as well. Pan (2002) considered that the early retirement age of women lead to a pension welfare loss, especially in the case of female employees with a longer life expectancy. Wu (2002) addressed the importance of considering gender difference when making pension policies and designing regulations. Li (2004) provided the evidences that in current Chinese retirement pension system, the female employees have a lower level of pension benefits than the male group, and this pension disparity enlarges continuously. Chen (2004) discussed the relationship between retirement age of female employees and their pension benefits intensity. Besides, the gender difference also exists in retirement annuities. Generally speaking, both of working span and wage level of female group are less than those of male employees. Zhu (2005) presumed that there were two main factors related to the male-female differential in social security scheme. One was gender discrimination within occupations which means that the number of female employees involved in the scheme is much less than the number of male employees. The other was the gender wage gap which made female employees contributing less to the pension funds than male employees.

Apparently, I am not the first one to study the gender difference of pension benefits in urban China, although the existing literature is rather limited. One possible reason for the lack of study on this topic in China is perhaps due to a general feeling among researchers that the gender difference of pension benefits in China has never been a serious problem. Another reason may stems from problems of data availability.

### 1.3 Research Questions and Goals

Most previous studies in China had concentrated on different retirement age and gender discrimination against women in the labor market, both of these two factors result in the gender inequality of pension benefits. As to my knowledge, the previous studies ignored the other important aspects that could cause the gender gap of pension benefits. For example, there is little study on pension-related factors which may affect the gender pensions gap. In addition, there are merely a few researches on the changes of gender pension difference in urban China.

Consequently, this paper attempts to fill the gap in the literature by analyzing the magnitude and change of the gender difference in pension benefits. Particularly, what is the impact of recent

pension reforms in urban China on gender difference of pensions? The main purpose of this study is seeking to answer the following questions: How large is the gender gap of pension benefits? Specially, is the gender gap increasing or decreasing over time? To what extent can gender differential in pensions be attributed to pension-related factors? And which factors have a dominant effect? To conclusion, what are the relevant implications of the empirical results to the policy makers for pension reform in urban China?

### 1.4 Structure of Paper

The rest of this paper is organized as follows. In part II, it reviews the major changes of pension benefits in urban China. I then explain the main provisions of the two pension reforms to the basic schemes promulgated in 1997 and 2006, and how they might have affected the male and female retirees. Part III describes the methodology and procedures employed for this research. The actuarial model is used to investigate the pattern and trends of gender gap in pension benefits for the future two decades. I also examine whether the gender gap in pension benefits can be attributed to differences in observed factors by using regression analysis. Part IV presents the data description and the definitions of variables. There are five main factors closely related to the gender pensions gap, which are sorted by gender and region. This is followed by a report of empirical results in Part V, where the different characteristics of gender gap in pension benefits are estimated and discussed. The final section, part VI offers the concluding remarks with underlying policy implications.

## PART II BACKGROUND

Basically speaking, a pension system is primarily a social security system for the elderly. The protection function of a pension system is achieved through a redistribution of income. In a pension system design, the income redistribution is generally from high-income earners to low-income earners. The female retirees usually receive less financial security than their male counterparts because of the gender difference in pension benefits. Thus, the pension system could not help the old-age women to maintain their basic living standards, and then it will influence the stability of social development. It is known that women are paid with lower wage

and they have longer survival time after retirement than men. In a consequence, the old-age women are facing a serious problem of economic insecurity. That is the reason why China's pension system has to take account of gender difference, and to adjust the distribution of pension benefits between men and women in a more effective way.

### 2.1 China's Urban Pension System and Reforms

The public pension system in China is composed of two elements, a basic pooling account on a pay-as-you-go basis and a funded individual account. The basic public pension has been playing an important role since it was established. The coverage of China's pension insurance is segregated between urban and rural populations. The current public pension system in China tries to cover all of the employees in urban areas, based on the *Decisions on Deeply Reforming Pension System of Enterprises* (Document No. 6) announced by the State Council on 1st March, 1995. [1]

In 1997, the State Council released the *Establishment of a Unified Basic Pension System for Enterprise Employees* (Document No. 26), which decided to pursue a unified basic pension system in the whole nation, including a unified contribution proportion of both employers and employees in respective levels, a unified percentage of individual accounts, and a unified formula of basic pension distribution.[2] This scheme shifts the burden of pension provisions from only the state to be shared by the state, employers, and employees together. And the pension system also moved from PAYGO financing to a combination of PAYGO and funded system.

Since the beginning of the 21st century, China has faced a severe challenge of a rapidly growing ageing population. The Chinese government has re-thought the pension system about the ageing issue. To cope with this concern, the Chinese government has implemented the pension reforms for urban enterprise workers. These reforms combined public pooling funds with individual accounts to raising money for the basic public pension, throughout the whole country. Public pooling and individual accounts are accumulated with money coming from employers and employees jointly. Employers and employees have to regularly deposit money

[1] For implementing the regulations, the Ministry of Labor and Social Security issued the appropriate policies in the *Rules of Enlarging Pension Coverage* (1999), which tries to expand the basic pension and individual accounts to all of the enterprises in urban areas, including state-owned enterprises, foreign funded enterprises, private enterprises, and individual business, etc.

[2] The calculation method of basic pension see Appendix 1A.

into the accounts. Nevertheless, the public pooling system has always been short of money since enterprises or government institutions do not have adequate money and some funds were used for non-social security matters. As a result, individual accounts are usually diverted to public accounts in order to pay pensions of retired people. The matter of empty accounts is growing more explicitly as well as the share of elderly population in China is growing larger and larger by the day.

The State Council Document (No. 38) the *Strengthening Pension Reform for Enterprise Employees* was published on 3rd December, 2005. It indicates that, starting from 2006, China began to implement a new scheme of urban pension system which aims to solve the worsening problem of empty accounts. The key components of the new scheme are an important modification of calculation method of pension payment, and a cut down size of individual accounts for the urban enterprise employees. [3] The new pension payoff is based on the time span of pension contributions. By applying this new scheme, the urban enterprise employees are generally concerned with the changes of pension receiving level and whether the basic standard of their living after retirement would be guaranteed.

### 2.2 Ageing Problem and Increased Life Expectancy

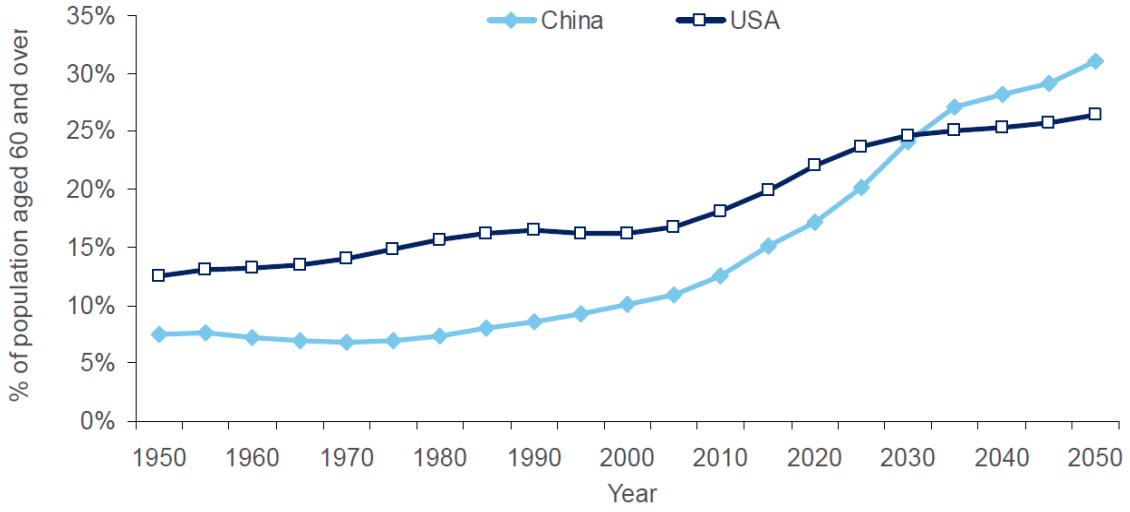
Unlike those of many European countries, the Chinese pension system is still in its infancy phase. Furthermore, it has to face grave challenges from the population ageing along with longer life expectancy.

Compared to other countries, China is ageing at an alarming pace (Sin, 2007). According to the United Nations, a population is generally considered to be "aged" if persons aged 60 and over account for more than 10 percent. On the basis of this definition, China had already become an ageing society at the beginning of this century. Figure 2.1 is the projected percentage of population aged 60 and over in China and the U.S. The United Nations predicted that the proportion of China's population aged 60 and over would reach 31% by 2050. This implies that one in three persons will be an elderly by that time. In contrast, the share of elderly population had exceeded 10% well before 1950 in the U.S. Over more than a century (1950-2050), the

[3] The adjusted calculation method see Appendix 1B.

American elderly proportion will reach 30% until after 2050. It is apparently that China only took half of the time which the U.S will take to experience a similar proportionate increase in the elderly population. As portrayed in Figure 2.2, the most proportion of the population concentrates on the age groups under 40 years old in 2005. It is in a relative favorable form since the ageing has not been a great problem. The population structure will shift to an unfavorable shape during the period of 2005-2035, and the ageing problem will become more serious. Owning to the "One-child Policy", the total fertility rate and the birth rate are rather low in China.[4] Thus, the biggest share of the population will move from the age groups of 10-19 and 30-39 in 2005 to the age groups of 40-49 and 60-69 by 2035.

**Figure 2.1 The percentage of elderly population over 60 years old in China and the U.S**

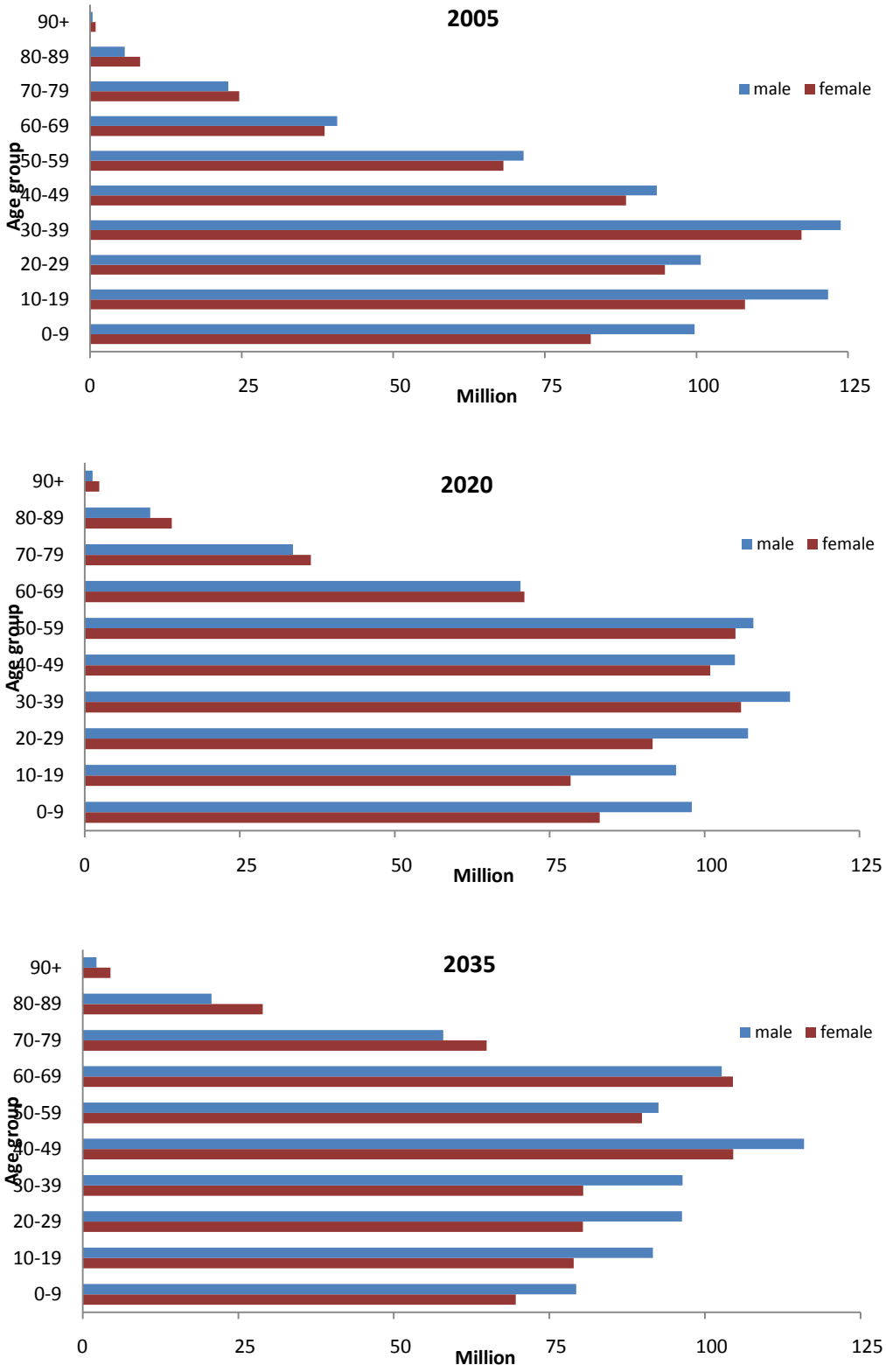



*Source*: World Development Indicator (2006)

The increasing life expectancy of Chinese people accounts for the ageing problem as well. Depending on a World Bank compilation of United Nations data in Figure 2.3, the average life expectancy at birth of Chinese is expected to reach 74.68 years old by 2011, and it rose about 3.3 years from 2000 to 2011. Specifically, the life expectancy at birth is 72.68 years old for men and 76.94 years old for women in 2011. These phenomena drive the pension system to expand and to cover more people, because an ageing population means additional people will need a pension payoff after they retire.

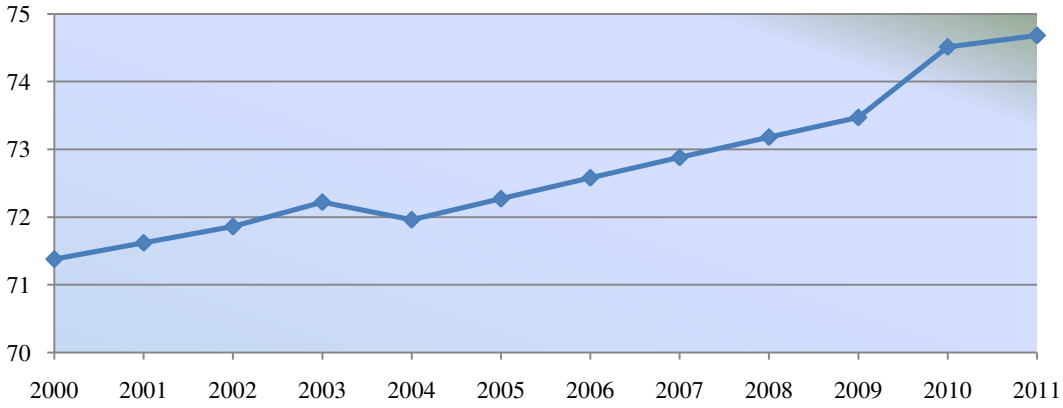
[4] CIA, The World Factbook – CHINA: the total fertility rate is 1.54 children born per woman, ranked 182 by country comparison to the world; the birth rate is 12.29 births/1,000 population, ranked 160 in the world.

**Figure 2.2 Population structure in China from 2005 to 2035**




*Source*: Own calculation base on the UN Population Database.

**Figure 2.3 China's life expectancy at birth between 2000 and 2011**




*Source*: CIA Factbook 2011

## 2.3 Factor Analysis of Gender Difference in Pension Benefits

There are many factors which influence gender difference in pension benefits. At this point, several important ones are chosen to be mentioned in the followings.

First, the rate of labor force participation is displayed in Table 2.1. It can be seen from this table that, in either the developed or the undeveloped areas, the labor force participation rates of men are higher than those of women. As to China, the labor force participation rate of male workers also is higher than female workers. And the gender difference of labor force participation rate became a little bit larger by 2010, although the participation rate of labor force slightly decreased from 2000 to 2010.

**Table 2.1 Participation rate of labor force aged 15-64**

Unit: %

| Year | Total | | Male | | Female | |
|---|---|---|---|---|---|---|
| | 2000 | 2010 | 2000 | 2010 | 2000 | 2010 |
| The world level | 73.3 | 73.2 | 85.5 | 84.6 | 60.7 | 61.5 |
| Developed area | 73.2 | 73.0 | 80.8 | 79.4 | 65.4 | 66.7 |
| Developing area | 73.4 | 73.2 | 86.7 | 85.7 | 59.5 | 60.4 |
| Undeveloped area | 76.8 | 76.8 | 87.6 | 87.3 | 65.8 | 66.2 |
| Asia level | 74.8 | 74.4 | 87.0 | 85.9 | 62.0 | 62.4 |
| China | 84.9 | 82.6 | 89.6 | 87.4 | 80.0 | 77.6 |
| Japan | 73.3 | 75.3 | 85.0 | 84.5 | 61.5 | 65.9 |
| Korea | 68.9 | 72.4 | 79.8 | 80.2 | 57.8 | 64.3 |

*Source*: The International Labor Organization (ILO)

Second, from the income level, female workers generally earn less than male workers in various occupations. An important reason is that the interruption of their working career for child birth. But such an interruption is rather short among mothers in urban China due to the "One-child Policy", which sets them apart from mothers in many other countries. In an international perspective, the gender wage gap in urban China appears to be relatively small. However, it is increasing.

Third, the different retirement ages in China between men and women affect their pension benefits after they retire. Women usually retire at least 5 years earlier than men. In the case of starting to work at the same age for men and woman, the working span of women must be 5 years less than men when women reach their retirement age, regardless of whether they are able to or willing to continue working. Additionally, women have longer life expectancy than men, and the life expectancy constantly increases over time. It means that female retirees live longer than male retirees after they retire. Therefore, the pension benefits for women are relatively much lower than those for men. This concern exits more commonly among high educated women as they spend longer time in further education and have a shorter working span.

Moreover, when western scholars analyzed the gender difference in pension benefits, they linked the gender pension gap to the differences in education level, employment patterns, occupations, industry sectors, union participation, raising children and marital status. These factors definitely have certain explanatory power on the gender difference of pension benefits. Unfortunately, I omitted some of these factors in my study because of the data availability.

## PART III METHODOLOGY

The main purpose of this paper is to estimate the magnitude of the gender differential of pension benefits and to analyze the reasons for this phenomenon. Accordingly, the first task is to describe the gender pension gap and its variation by constructing an actuarial model. A second task is to run a regression model to attribute the gender pension gap to differences in variables and differences in coefficients.

### 3.1 Actuarial Model Simulation of Future Gender Difference in Pension Benefits

It is well known that in China the female urban employees are disadvantaged in the labor market compared with male urban employees. In general, women with the same personal endowments as men receive fewer wages. Moreover, female workers are compulsory to retire earlier than male workers. It is consequently inevitable to deal with the gender difference in pension benefits. How large is it and what is the change of this gender gap under the new social security system over time?

### 3.1.1 Ideas of model construction

I will employ the relative value method to examine the magnitude of gender pension gap in the actuarial model. The measurement of relative value is directly to observe the gender difference in pension benefits between male and female workers in a proportion way, that is, the ratio of female-male pension benefits. There are two concepts involved when I get the relative value of gender gap of pension benefits. One is the *overall* gender difference, which is to express the total ratio of female-male pension benefits of all retired workers in the urban area by a fixed year. The other is the *average (mean)* ratio of gender difference by eliminating the demographic factor.

The actuarial model described in the followings is inspired by Zhang *et.al* (2007) who studied the gender difference in pension benefits of Chinese employees. Before planning the steps of the model build up, the meanings of parameters need to be denoted at the beginning so as to make the equations much easier to understand. The definitions of parameters are below,

$G$ = *overall ratio* of female-male pension benefits of urban employees;

$\overline{G}$ = *average ratio* of female-male pension benefits of urban employees;

$Q_n^m$ = total pension payment for *male* employees in year $n$;

$Q_n^f$ = total pension payment for *female* employees in year $n$;

$\overline{W_{x,n}^m}$ = average wage of *active male* employees at age $x$ in year $n$;

$\overline{W_{x,n}^f}$ = average wage of *active female* employees at age $x$ in year $n$;

$L_{x,n}^m$ = average population of *retired male* employees at age $x$ in year $n$;

$L_{x,n}^f$ = average population of *retired female* employees at age $x$ in year $n$;

$\overline{B_{x,n}}$ = average pension benefits received by retirees at age $x$ in year $n$;

$a$ = age of start working for both male and female employees;

$b^m$ = retirement age of *male* employees;

$b^f$ = retirement age of *female* employees;

$\omega$ = maximum age of life span for both male and female employees.

$x$ = age of employees at year $n$.

In general, the overall pension payment of employees in year $n$ is,

$$Q_n = \sum_{x=b}^{\omega-1} L_{x,n} \overline{B_{x,n}} \tag{1}$$

The average annual wage of active employees at age $x$ in year $n$ is,

$$\overline{W_{x,n}} = \overline{W_{a,1}}(1+g_{y1})^{x-a}(1+g_{y2})^{n-1} \tag{2}$$

$\overline{W_{a,1}}$ is the average wage of $a$-year old active employees in base year, $g_{y1}$ is yearly growth rate of wage influenced by a personal factor,[5] $g_{y2}$ is yearly growth rate of wage influenced by a social factor.[6]

The average pension benefits of retired employees are expressed as the product of the wage of employees in the year before they retire multiplied by the average replacement rate $T_a$ and the yearly adjusted rate of pension benefits $k$,

$$\overline{B_{x,n}} = T_a \overline{W_{a,n-x+a}}[(1+g_{y1})(1+g_{y2})]^{b-a-1}(1+k)^{x-b} \tag{3}$$

Substituting formula (2) and (3) into formula (1), we can get the total payment of pension benefits for retirees. Thus, the total payment of pension benefits for *male* retirees is,

$$Q_n^m = \sum_{x=b^m}^{\omega-1}[T_a \overline{W_{a,1}^m}(1+g_{y1}^m)^{b^m-a-1}(1+g_{y2}^m)^{n-x-2+b^m}](1+k)^{x-b^m} L_{x,n}^m \tag{4}$$

[5] Personal factor points to the factors such as rising in seniority, improved proficiency level, etc. that affect wage growth rate.
[6] Social factor points to the factors such as socio-economic development and inflation etc. that influence wage growth rate.

Similarly, the total payment of pension benefits for *female* retirees is,

$$Q_n^f = \sum_{x=b^f}^{\omega-1}[T_a \overline{W_{a,1}^f}(1+g_{y1}^f)^{b^f-a-1}(1+g_{y2}^f)^{n-x-2+b^f}](1+k)^{x-b^f} L_{x,n}^f \tag{5}$$

The ratio of formula (5) to (4) is the *overall* female-male difference in pension benefits,

$$G = \frac{Q_n^f}{Q_n^m} = \frac{\sum_{x=b^f}^{\omega-1}[\overline{W_{a,1}^f}(1+g_{y1}^f)^{b^f-a-1}(1+g_{y2}^f)^{n-x-2+b^f}](1+k)^{x-b^f} L_{x,n}^f}{\sum_{x=b^m}^{\omega-1}[\overline{W_{a,1}^m}(1+g_{y1}^m)^{b^m-a-1}(1+g_{y2}^m)^{n-x-2+b^m}](1+k)^{x-b^m} L_{x,n}^m} \tag{6}$$

Based on the formula (6), eliminating the demographic factor $L$, we obtain the ratio of *average* female-male difference in pension benefits,

$$\overline{G} = \frac{\sum_{x=b^f}^{\omega-1}[\overline{W_{a,1}^f}(1+g_{y1}^f)^{b^f-a-1}(1+g_{y2}^f)^{n-x-2+b^f}](1+k)^{x-b^f}}{\sum_{x=b^m}^{\omega-1}[\overline{W_{a,1}^m}(1+g_{y1}^m)^{b^m-a-1}(1+g_{y2}^m)^{n-x-2+b^m}](1+k)^{x-b^m}} \tag{7}$$

#### 3.1.2 Assumptions and parameter settings

The State Council Document No. 38 (2005) is still a pilot project, in which the new scheme has not been implemented throughout the whole country. [7] To unify the pension payment calculation in different regions, I suppose that the State Council Document No.38 (2005) is implemented in national wide starting on January 1st, 2011 and the policies remain unchanged till 2032 in China. And I believe that the pension coverage rate is identical to both urban male and female employees.

Individual differences among employees exist when they receive the pension benefits. However, this actuarial model only analyzes the gender gap of pension benefits, where individual differences are not involved. For that reason, I assume that every employee receives the average pension benefits for male and female, respectively.

[7] Based on the full investigation and conclusion of pilot experience in the three northeast provinces, the State Council improves the urban social security system for the basic old-age enterprise employees insurance

Before running this actuarial model with available data, it is important to illustrate the idea of how the values of these parameters are determined.

(1) $n$, the prediction interval $n$ is supposed to be 22 years (2011-2032). China's aging problem will be getting serous in the next two decades. The proportion of population above 65 in China will surpass that of Japan in 2030,[8] which will make China the world's most aged society.

(2) $a$, the State Council Document No. (2005) regulates that all employees are eligible to enter the pension system when they start working. In the same way as Zheng (2006), I assume people begin to work and are involved in pension insurance at the age 20.

(3) $b^m$ and $b^f$, in the light of China's Labour Law,[9] the legal retirement ages for women are 55 for those who working for government institutions or companies and 50 for blue-collar workers, respectively, while the male workers uniformly are retired at the age 60. The physical condition of workers has been improved with the healthcare system establishment. And the working lifespan of female employees with a gradual increase as well. Thus, I set up the retirement age 60 for male employees, and 55 for female employees. That are $b = 60$ and $b^{'} = 55$.

(4) $\omega$, referring to the data of Chinese Working Population Life Table (1989-1990), the age 90 is assigned as a general upper limit age of the life expectancy.

(5) $g_{y1}^m$ and $g_{y1}^f$, taking the examples from Zhou (2004) and Wang et al. (2002), I assume that in 2011 the wage growth rate affected by male personal factor is $g_{y1}^m = 1.2\%$, the wage growth rate affected by female personal factor is a little bit higher, $g_{y1}^f = 1.5\%$. There are a few study findings indicate that the economic performance of China is far behind the United States. So, I adopt the American average wage growth rate 2.1% [10]as the target value in 2032. I use a constant annual growth rate to estimate $g_{y1}^m$ and $g_{y1}^f$ from 2011 till 2032, respectively.

[8] This is according to the report released by Chinese Academy of Social Sciences (CASS) (2010).
[9] Adopted at the 8th National People's Congress on July 5, 1994, promulgated by Order No.28 of the President of the People's Republic of China on July 5, 1994, and effective as of January 1, 1995
[10] This number is cited from OECD Employment Outlook (2007).

(6) $g_{y2}^{m}$ and $g_{y2}^{f}$, the estimations of $g_{y2}^{m}=4.7\%$ and $g_{y2}^{f}=5\%$ in 2011 are cited also from the examples of Zhou (2004) and Wang et al. (2002). The social factor should be fit with the national economic development level, thus the target value of $g_{y2}^{m}$ and $g_{y2}^{f}$ is 5.5% in 2032.

(7) $\overline{W_{a,1}^{'}}/\overline{W_{a,1}}$, 2011 is the base year so that $\overline{W_{a,1}^{'}}/\overline{W_{a,1}}=\overline{W_{2011}^{'}}/\overline{W_{2011}}$. The General Survey (2000) shows that the average wage ratio of female-male workers is 70.1% in 1999,[11] which increased 7.4%, compared with the result of survey in 1990. According to the findings of Li (2004), I assume $\overline{W_{2011}^{'}}/\overline{W_{2011}}=80\%$ in the actuarial model.

(8) $k$, during 2000-2008 the actual mean wage growth rate is 10.61%, in the meantime, the average growth rate of GDP is 10.75%, the ratio of these two indexes is 0.987.[12] This small differentiation could be omitted, and I assume the wage growth rate grow in pace with GDP. Additionally, the growth rate of GDP among 2021-2030 is approximately to 5.5% as predicted by the NBSC. In this model I suppose 5.5% as the annual mean growth rate of wage through whole prediction period. Besides, the accrual of pension benefits weight cannot beyond 60% of the accrual of average wage of previous year. Thus, the estimated value of $k$ is 3.3% ($5.5\%\times 60\%$).

#### 3.1.3 Simplified model and prospect population of retirees

After determining all the parameters, the simplified equations could be generated. These simplified equations are used in practice when running the actuarial model. Substituting the value of parameters into formula (7),

$$G=0.8\cdot\left(\frac{1+g_{y1}^{f}}{1+g_{y1}^{m}}\right)^{34}\cdot\left(\frac{1+g_{y2}^{f}}{1+g_{y2}^{m}}\right)^{53+n}\cdot\left[\frac{1.033}{(1+g_{y1}^{m})\cdot(1+g_{y2}^{f})}\right]^{5}\cdot\frac{\sum_{x=55}^{89}(1+g_{y2}^{f})^{-x}\cdot 1.033^{x}\cdot L_{x,n}^{f}}{\sum_{x=60}^{89}(1+g_{y2}^{m})^{-x}\cdot 1.033^{x}\cdot L_{x,n}^{m}} \qquad (8)$$

[11] This General Survey was jointly organized by All-China Women's Federation and National Bureau of Statistics of China (NBSC) in 30 provinces and 404 cities with 48192 respondents. If suppose the average wage of male workers is 100, then the average wage of female workers is 70.1.
[12] China Statistical Yearbook 2009.

Given $A = 0.8 \cdot (\frac{1+g_{y1}^{f}}{1+g_{y1}^{m}})^{34} \cdot (\frac{1+g_{y2}^{f}}{1+g_{y2}^{m}})^{53+n} \cdot [\frac{1.033}{(1+g_{y1}^{m}) \cdot (1+g_{y2}^{m})}]^{5}$, instead of formula (6) and (7), the simplified formula of *overall* and *average* gender difference of pension benefits are,

$$G = A \cdot \frac{\sum_{x=55}^{89} (1+g_{y2}^{f})^{-x} \cdot 1.033^{x} \cdot L_{x,n}^{f}}{\sum_{x=60}^{89} (1+g_{y2}^{m})^{-x} \cdot 1.033^{x} \cdot L_{x,n}^{m}} \tag{9}$$

$$\overline{G} = A \cdot \frac{\sum_{x=55}^{89} (1+g_{y2}^{f})^{-x} \cdot 1.033^{x}}{\sum_{x=60}^{89} (1+g_{y2}^{m})^{-x} \cdot 1.033^{x}} \tag{10}$$

Replacing the collected data into formula (9) and (10), we would obtain the prediction value of average difference between male and female pension benefits in coming two decades. In that way, how large the gender gap is in the future can be estimated specifically in the perspective of quantity.

### 3.2 Analysis of Factors on Gender Difference in Pension Benefits

After simulating the gender difference of pension benefits in the next two decades, we will know how big the gender gap is and whether this gap is significant or not. However, in the actuarial model, we could not find out the main factors that cause this gender gap, and which factor has a major effect. We then need another model to deal with these questions and to further observe the changes of the gender gap when a certain factor is fixed.

For this purpose, I make use of multiple-regressions to attribute the gender pension gap to differences in variables and in coefficients. The multiple-regression is nowadays a normal technique for analyzing the gender difference in pension benefits. Before presenting the regression analysis, I present the descriptive statistics in section 4.4 to summarize the factors (variables). This analysis makes an in-depth study in the effect of factors on pension benefits, and discovers the relationship among factors by comparing the variation of gender coefficient in regression models. The analysis proceeds along with several steps.

### 3.2.1 Model

The idea of the multiple regression models is inspired by Zhang (2010). By using a multiple linear regression analysis, Zhang (2010) examined the relevant factors and their effect on gender difference in the pension benefits of elderly in Shanghai in 2003. In my paper, the design of a set of multiple regression models is as follows. Firstly, I build up a standard model simply containing two variables, namely gender and pension benefits. In this way, I will obtain the coefficient $\beta_{gender}^{standard}$ of gender variable, representing the total effect of gender factor on pension benefits. Secondly, I run a complete model which comprises gender variable and other pension-related variables. Then, the direct effect, coefficient $\beta_{gender}^{full}$, of gender variable on the pension benefits can be estimated. Further, I will exclude one of the explanatory variables from the complete model except for the gender variable, and remain all the other variables unchanged. A nested model will be produced consequently. The complete model and each nested model can estimate a gender coefficient $\beta$. Then I calculate the exponential function of $\beta$ in every model, which can be expressed as $\exp\beta$.

Standard model: $$Y = \beta + \beta_{gender} X_{gender} + error \quad (11)$$

The dependent variable $Y$ is the logarithm of pension benefits. The independent variable $X_{gender}$ is a dummy variable, $X_{gender} = 1$ if female or $X_{gender} = 0$ if male. $\beta_{gender}$ is the coefficient of gender variable, and its value means the total effect of gender variable on pension benefits. The exponential function $\exp\beta_{gender}$ is the absolute value of average ratio of female-male pension benefits.

Complete model: $$Y = \beta^{'} + \beta_{gender}^{'} X_{gender} + \beta_{covariant} Z_{covariant} + error \quad (12)$$

$Y$ and $X_{gender}$ have the same meanings as in the formula (11). $Z_{covariant}$ is the vector of the other effect factors (covariant), and $\beta_{covariant}$ is the vector of covariant coefficient. $Z_{covariant}$ comprises five effect factors in the complete regression which are *working experience*, *retirement age*, *education attainment*, *earnings*, and *employment occupations*[13]. The coefficient

[13] The explanation of standards of choosing these variables is in section 4.2

$\beta'_{gender}$ is the direct effect of gender factor on pension benefits gap. The exponential function $\exp \beta'_{gender}$ is the relative value of average ratio of female-male pension benefits.

Nested model: $$Y = \beta'' + \beta''_{gender} X_{gender} + \beta'_{\text{covariant}} Z'_{\text{covariant}} + error \quad (13)$$

A series of nested regression model can be deduced from the complete model. The vector $Z'_{\text{covariant}}$ excludes one of the five effect factors as the other factors are maintained. Each nested model estimates its own gender coefficient $\beta''_{gender}$ and these $\beta''_{gender}$-s are different from the gender coefficient $\beta'_{gender}$ in value. Identically, the values of $\exp \beta''_{gender}$ in each nested model are different from $\exp \beta'_{gender}$ in the complete model as well. $\exp \beta'_{gender}$ indicates the average ratio of female and male pension benefits of the full model while $\exp \beta''_{gender}$ stands for the average ratio of female and male pension benefits of the nested model.

After running all of these regression models, the next step is to analyze the gender pension gap for the selected sample years by using the estimations from the models. I will study the significance of each explanatory variable on gender difference of pension benefits through comparing the $\exp \beta$ in the complete model and the nested models.

### 3.2.2 Variables

*Independent variables*: this multiple regression analysis includes six independent variables including gender, working experience, education attainment, employment occupations, earnings, and retirement age. Retirement age, working experience, and earnings are the continuous variables. The other three variables are dummy variables. [14] The specification of each variable is demonstrated below.

Gender, $X_{gender} = 1$ if female, or $X_{gender} = 0$ if male.

Education attainments, it comprises five levels.

$X_{primary} = 1$ if primary school, otherwise $X_{primary} = 0$.

[14] Dummy-variable can be used to incorporate qualitative explanatory variables into a linear model, substantially expanding the range of application of regression analysis.

$X_{junior} = 1$ if junior school, otherwise $X_{junior} = 0$.

$X_{senior} = 1$ if senior school, otherwise $X_{senior} = 0$.

$X_{coll\&uni} = 1$ if college or university, otherwise $X_{coll\&uni} = 0$.

Employment occupations, it includes five sectors.

$X_{worker} = 1$ if production, operation, or transportation workers, otherwise $X_{worker} = 0$.

$X_{business} = 1$ if business employees, otherwise $X_{business} = 0$.

$X_{clerk} = 1$ if clerks or social service, otherwise $X_{clerk} = 0$.

$X_{officer} = 1$ if government agencies or public institutions, otherwise $X_{officer} = 0$.

Thus, the vector of covariant is

$$\beta_{covariant} Z_{covariant} = \begin{pmatrix} \beta_{retirement\_age} \\ \beta_{working\_experience} \\ \beta_{earnings} \\ \beta_{primary} \\ \beta_{junior} \\ \beta_{senior} \\ \beta_{coll\&uni} \\ \beta_{worker} \\ \beta_{business} \\ \beta_{clerk} \\ \beta_{officer} \end{pmatrix}' \begin{pmatrix} V_{retirement\_age} \\ V_{working\_experience} \\ V_{earnings} \\ X_{primary} \\ X_{junior} \\ X_{senior} \\ X_{coll\&uni} \\ X_{worker} \\ X_{business} \\ X_{clerk} \\ X_{officer} \end{pmatrix}$$

And the complete model is,

$$Y = \beta^{'} + \beta_{gender}^{'} X_{gender} + \begin{pmatrix} \beta_{retirement\_age} \\ \beta_{working\_experience} \\ \beta_{earnings} \\ \beta_{primary} \\ \beta_{junior} \\ \beta_{senior} \\ \beta_{coll\&uni} \\ \beta_{worker} \\ \beta_{business} \\ \beta_{clerk} \\ \beta_{officer} \end{pmatrix}^{'} \begin{pmatrix} V_{retirement\_age} \\ V_{working\_experience} \\ V_{earnings} \\ X_{primary} \\ X_{junior} \\ X_{senior} \\ X_{coll\&uni} \\ X_{worker} \\ X_{business} \\ X_{clerk} \\ X_{officer} \end{pmatrix} + error \qquad (15)$$

*Dependent variable:* for $Y$, the logarithm $Y$ is used instead of the actual pension benefits, which makes $Y$ close to (logarithmic) normal distribution.

### 3.3 Summary of Methodology

The analysis of these two models will calculate the gender pension gap, and find out which factors significantly influence the gender gap of pension benefits in urban China. Observing and comparing the results of gender gap changes in pension benefits, it might provide some useful evidence to policy makers. And the later pension system reforms in China should distribute the pension payoff between male and female retirees in a more equal way.

## PART IV DATA AND DESCRIPTIVE STATISTICS

This paper primarily focuses on gender differences in pension benefits of urban employees. The samples used in this study are concerned with those living in urban area as the current Chinese pension system and mandatory retirement policies formally exist in the urban area, but effectively absent in the rural area. Although I only examine the urban employees of China, it is a labor force larger than the total population in any other single country except for India. The reason for excluding the rural population from the research objects is that so far China's pension system does not cover the rural area. However, the recent pension reforms in China attempt to

expand the pension coverage in rural area so as to protect the basic living standard of rural residents when they retire. Here I suggest that as another major composition of the population in China, the rural population would be involved in later studies.

As an exploratory study, a few statistical data sets will be employed in the following data analysis. All the reference data are the results of national sample survey so that there might be some compatibility within these data. In addition, the core issue of this paper is not to make an accurate prediction of retirees' pension benefits by gender, but points to analyzing that how large is the gender gap of pension benefits and how the different parameters influence this gender gap. The research goals will be achieved effectively by using the following data.

### 4.1 Data Sources

Data source is the basis of data collection. It needs a careful decision to make sure the reliability of the data sets. Thus, I prefer to pick up the data published by government agencies or organizations with high credibility. The panel data used in this paper comes from the following three major sources.

*A. United Nations (UN)*

All the parameters of the actuarial model (mentioned in section 3.1.4) have been assumed with certain numbers except the size of old-age urban population in the future two decades. The data used for the estimation of urban elderly population in China is derived from the Population Division Department of Economic and Social Affairs of the UN Secretariat. There are two data sets I have chosen from the UN Population database, one is *World Population Prospects: the 2008 Revision*, and the other is *World Urbanization Prospects: the 2009 Revision*.[15] These two data sets contain the latest estimates and projections of the population for the all countries in the world which are classified by various categories.

*B. National Bureau of Statistics of China (NBSC)*

One of the data sources for the multiple-regression analysis (section 3.2) comes from the NBSC. The NBSC is a government organization which incorporates with several ministerial

[15] http://esa.un.org/unpp/index.asp?panel=1, http://www.un.org/esa/population/

statistical agencies of China and provides authoritative statistical data. The collected data sets for the main variables of the regression analysis are derived from the bulletin of *5th National Population Census 2000*[16] and *China 1% Population Sample Survey 2005*[17] on the NBSC's official website. These two census data contain the total population of registered residents by gender and by age groups.

*C. Ministry of Human Resources and Social Security of China (MOHRSS)*

MOHRSS is another data source for the main variables of the regression analysis. It is a ministry which is responsible for national labor policies, standards, regulations, and managing the national social security. The collected data sets are adjusted on the basis of the *China Statistical Yearbook (2000) & (2009)* compiled by MOHRSS. These annual statistical publication cover some key statistical data in the most recent thirty years and some historically important years at the national level and the local level of province, autonomous region and municipality directly under the Central Government. It includes the chief indicators of national labor statistics, number of employment by sector, total wages of staff and workers by sector, educational attainment, composition of employment by age and sex, etc. These summary data of annual yearbook comprehensively reflect the situation of population, economic and social welfare development of China.

### 4.2 Variable Specification

Although there are many factors might affect on the gender gap of pension benefits I would like to choose five key variables which are much more strongly related to pension benefits.

Gender discrimination do exists in the gender difference of pension benefits. However, it is not the only reason for a pension gender gap. Under the current Chinese pension system, the pension benefits of an individual urban employee are highly related to earnings and years of employment (active service). Earnings are defined as the individual income of active workers obtained from their work units. [18] The female employees usually are lower paid than male employees, no matter whether they possess the same personal endowment or not. According to

[16] http://www.stats.gov.cn/tjsj/ndsj/renkoupucha/2000pucha/pucha.htm (Chinese version)
[17] http://www.stats.gov.cn/tjsj/ndsj/renkou/2005/renkou.htm (Chinese version)
[18] Earnings consist of four major components, i.e., basic wage (or net revenue), bonus, subsidies, and other income

the pension reform put forward in 2005, the standard of pension grant to a retiree is related to his/her pension contribution period. The pension contribution period could be approximated by the years of employment[19] which is referred to as working experience hereafter. The higher the relationship between pension received and working experience or earnings, the more disadvantage to female employees. For that reason, earnings and working experience are the key factors that might great affect a pension gender gap.

Moreover, the level of education attainment directly influences the employment pattern of an individual. The NBSC of China reports that employees with higher levels of educational attainment earn more and are less likely to be unemployed. The education level impacts employees throughout their participation in the workforce, as well as their retirement outlook. And the China Labor Statistical Yearbook has been using the levels of education as one of the classification criterion since 1995.

According to the "crowding" effects, the occupational segregation of gender is not only rooted in the discrimination against women within the same occupation, but also stems from the different gender occupational distributions (Bergmann 1974). In other words, the careers open to women are very limited within a separate labor market from the one for male workers, so that female workers are mostly concentrated in some particular occupations. A large labor supply of female workers in these occupations causes a decline of wage level. It is hard for women entering into the male-dominated careers, and a relative lack of professional labor supply in these careers leads to a higher wage level. The wage gender gap among occupations consequently results in a gender difference of pension benefits.

A different retirement age of male and female workers affects the gender pension benefits distribution in two ways and it may influence the women's employment rights. In the former case, on the one hand, a lower retirement age means lower wages and shorter length of active service of an employee. Correspondingly, a lower retirement age also means less pension contributions during a working period. The pension policy is regulate that the pension benefits are related to wage level, length of service or pension contribution period, the earlier retired female workers thus will get a lower share of pension benefits. On the other hand, a lower

[19] It assumes that an urban employee is involved in the pension system as soon as he starts to work until his retirement.

retirement age also implies that a worker will enjoy retirement pension earlier and will have a longer collection time of pension benefits.

### 4.3 Data Selection

For the calculation of the actuarial model I use the data of urban population in China[20] by sex and age group collected from the UN population database. As mentioned before, I mean to measure the gender difference in pension benefits of retirees in the actuarial model. Firstly, I predict the urban population of elderly with the annual change of urbanization rate. And the retirement age differs five years between male and female workers. I classify the age groups of retirees starting from 55 and 60 for female and male workers, respectively, and ending up at age 89 for both sexes due to the maximum age is assumed to be 90 in section 3.1.4. The annual population database of the UN is estimated by every five-year age group, thus there are seven age groups for female retirees while six groups for male retirees. [21] The time horizon to estimate the urban elderly population by gender is from 2000 to 2032. [22] The time period 2000-2010 is chosen to observe the change of urban elderly population, comparing with the prediction interval 2011 to 2032.

As to the multiple regressions analysis, the idea is to find out how the factors impact the pension benefits differential between genders and which factor(s) plays the main role in this pension gender difference. There is an enormous database for Chinese yearly statistical data, and it is neither necessary nor realistic for me to use the entire database to generate the regression model. Thus, I build up two data sets for the selected years 1999 and 2008 to do my analysis. Referring to the sample year 1999, it is at an early phase of the pension reform process which was first initiated in 1997. Eight years later the three pillar pension system has been established, that is in 2005. Another sample year 2008 is chosen to study the influence on the gender difference of pension benefits with the changes of pension policy.

[20] For the statistical purpose, the data for China do not include Hong Kong and Macao, Special Administrative Regions (SAR) of China.
[21] The seven age groups for female retirees are 55-59, 60-64, 65-69, 70-74, 75-79, 80-84 and 85-89. Whereas the six groups for males are 60-64, 65-69, 70-74, 75-79, 80-84 and 85-89. The starting age of female and male retirees vary because of the five-year difference of retirement age.
[22] The whole time period of estimations of UN population database is from 1950 to 2050 and the data is estimated by every 5 years.

The two data sets in my research basically cover four centrally administrative municipalities, *Beijing, Shanghai, Chongqing* and *Tianjin*, and one major city *Guangzhou*[23] with economic development at high speed and top urbanization. The data of these two sample sets are mainly derived from two national population censuses performed by a similar design and instrumented by various categories which are the *5th National Population Census* in 2000 and the *1% Population Sample Survey* in 2005. The figures of these data sets are estimated from the annual national sample survey on population changes. The sample selection criterion of the original data sources is one person out of a million population. For the simplicity, the sample size of my two data sets is 1% of the size of original ones. There are 2287 male retirees and 2121 female retirees in 1999 data set and in 2008 data set there are 3058 male retirees and 3022 female workers. I believe that the sample size is large enough to create the representative results. The specific figures of samples by genders and regions are displayed in Table 4.1 below.

**Table 4.1** **Specific sample sizes by gender and region in two sampling years**

| Region | *1999* | | | *2008* | | |
|---|---|---|---|---|---|---|
| | Male | Female | Total | Male | Female | Total |
| Beijing | 498 | 452 | 950 | 812 | 796 | 1608 |
| Shanghai | 659 | 613 | 1272 | 956 | 943 | 1899 |
| Tianjin | 272 | 261 | 533 | 395 | 399 | 794 |
| Chongqing | 340 | 320 | 660 | 457 | 453 | 910 |
| Guangzhou | 518 | 476 | 994 | 438 | 431 | 869 |
| Total | 2287 | 2121 | 4408 | 3058 | 3022 | 6080 |

Unit: person

The factors (variables) effect on pension benefits considered in the regression analysis are gender, working experience, retirement age, education attainment, earnings, and employment occupations (section 3.2.1), I select the data which are relevant to these six variables for the two sample data sets from the *China Labour Statistical Yearbook* 2000 and 2009. As mentioned in section 3.2.2, education attainment is composed of five levels: primary school, junior school, senior school, university and college, graduated and above. Besides, I integrate the whole occupational segregation into five groups: public organization sector, professional and technical

[23] Economic growth has been much faster in Guangdong province which was first opened to foreign investments since 1979. Guangzhou as the provincial capital of Guangdong province, its development has been particularly rapid and its average household income is very high by Chinese standards.

sector, business service sector, clerks and workers sector, production and transportation and operation workers sector. This occupational assortment is inspired by Zhang et al. (2008).

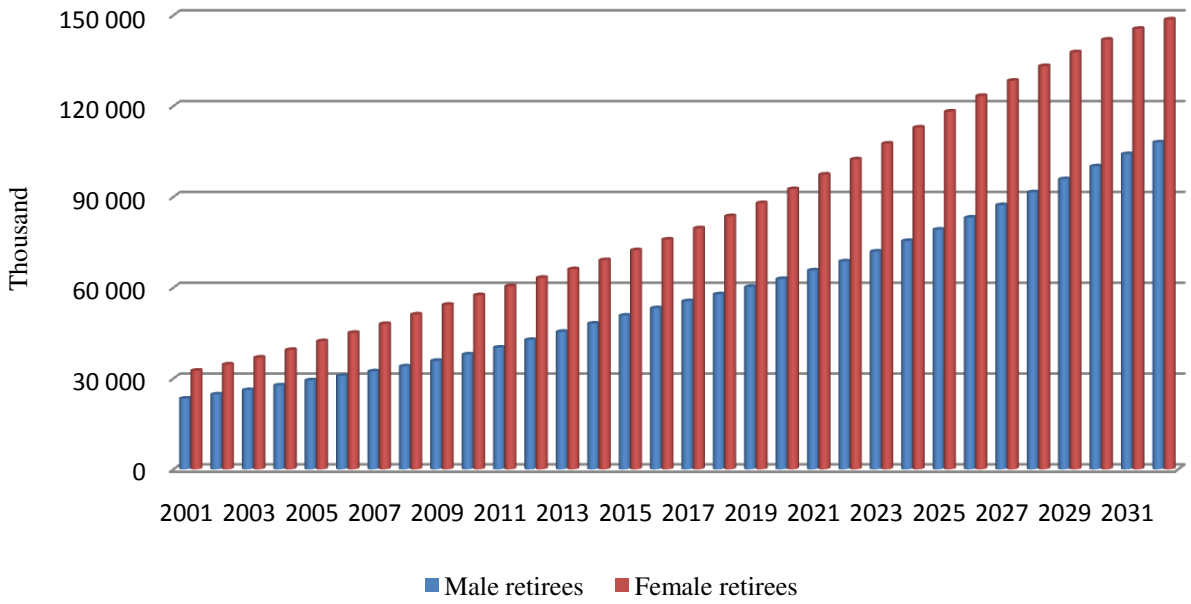
Additionally, in the actuarial model it supposes that the mandatory retirement age of female workers is 55 and 60 for male workers, but in reality, individuals retire at a variety of ages. In line with the samples in the data sets, the expected retirement ages of different workers are in a range of 50-59 for women and 55-64 for men. Based on the original data sources, working experience equals to retirement age minus 6 minus years of schooling. The earnings are selected as the annual average real wage in urban units (involving state-owned enterprise, collective and joint-venture enterprise and others) by occupations, education levels, and working experience. Another thing should be mentioned is that the data sets contain hired workers before their retirement only and exclude self-employed workers for simplicity. Furthermore, the computation methods of pension benefits are different for these two data sets because of policy changes. The samples in 1999 data set will use the provision of pension calculation in 1997 pension reform while the 2008 sample data set will use the calculation method revised in the State Council Document 2005. [24]

### 4.4 Descriptive Statistics of Variables

The estimated urban population of retirees in China within the model projection interval 2011-2032 is tabulated in Table 4.2 by every 5-year age group and gender. The population of each age group increases by years for both genders except for the female age group 55-59. The maximum population will be reached in 2028 and will start decreasing from then on. The proportion of female age group 55-59 will decline from 31% in 2011 to 21% in 2032 while the proportion of other age groups of the female retirees will keep growing more or less. The same pattern is revealed for the male retirees but not as prominent as the females. The proportion of the male age group 60-64 will reduce 4% by 2032 with the proportions of other male age groups increasing. The total elderly population of both female and male are doubled or tripled during the prediction interval 2011-2032. This shows the emergence of, an ageing population.

[24] The details of the different pension benefit computation described in Appendix.

**Figure 4.1 Old-age urban population change by sex between 2001 and 2032**




In addition, Figure 4.1 shows the population change of urban retirees from 2001 to 2032 in a more visual way. The previous decade is involved in order to make a comparison between it and the prediction interval. The urban retiree population of both sexes keeps increasing over time. The old-age female population grows faster than males, and the old-age population of both genders are expanding in a dramatic speed. In 2001, the old-age female urban population is 33 million and it will boost to 149 million at the year of 2032. Similarly, the male population will rise from 23 million in 2001 to 108 million in 2032. The total population of elderly women is more than old-age men along the whole period. And the population difference between women and men becomes larger and larger. The possible reasons for this phenomenon might be the increased life expectancy, where women have a longer retirement life than men in general, and the urbanization growth[25] quickly which leading to more urban female residents.

Table 4.3 uses the two sample data sets 1999 and 2008 to portray the descriptive statistics of the pension-related variables by gender. There are some gender differences in the occupation composition of the labour force which can be commented on. Both data sets indicate that female workers occupy higher proportions than male workers in the occupations with a lower wage level.

[25] The main sources of urban population growth are official locality change (34%), unofficial migration (28%), natural increase (19%), new towns enter in urban area (12%) and agricultural non-agricultural change (7%), OECD Economic Surveys – CHINA 2010.

While in the occupations with a higher wage level, the proportion of female workers is much lower, relative to their male counterparts. These differences between genders are statistically significant. The proportions of male employees in public organization sector, and professional and technical sector are much higher than females, and this distance became larger in 2008 compared to 1999. On the contrary, the proportions of female employees in business service sector, and clerks sector are bigger than males, and the difference enlarged in 2008 as well. This implies that the female employees are at a disadvantage in the working place. The proportion of male employees in the production, transportation and operation sector with lower payment is higher than female workers. This might because males are superior in physical endowment for this kind of work.

There is also an important pattern of the education breakdowns in Table 4.3. In 1999, the education attainment above junior school of male employees accounts for 36.17% which is larger than the proportion 33% of female employees. Whereas the percentage of lower education level for female employees is 67% that is much higher than male employees. It means that males have more opportunities for further education than females. This phenomenon is rooted in the special historical and cultural reasons in China. However, this situation has been improved by 2008. The difference of education attainment between male and female employees reduced, although the males still possess a higher education level on average than females.

**Table 4.2 Urban population estimation of retirees by gender and age groups from 2011 to 2032 (thousand)**

| Year | Female | | | | | | | Male | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85-89 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85-89 |
| 2011 | 18 703 | 13 941 | 9 549 | 7 553 | 5 725 | 3 385 | 1 577 | 14 322 | 9 752 | 7 388 | 5 080 | 2 636 | 1 024 |
| 2012 | 18 778 | 15 372 | 10 161 | 7 749 | 5 928 | 3 588 | 1 670 | 15 647 | 10 331 | 7 567 | 5 280 | 2 802 | 1 093 |
| 2013 | 18 675 | 16 834 | 10 900 | 7 979 | 6 122 | 3 800 | 1 768 | 16 999 | 11 027 | 7 770 | 5 471 | 2 972 | 1 166 |
| 2014 | 18 700 | 18 108 | 11 795 | 8 282 | 6 308 | 4 010 | 1 875 | 18 187 | 11 859 | 8 035 | 5 652 | 3 142 | 1 244 |
| 2015 | 19 107 | 19 054 | 12 869 | 8 694 | 6 500 | 4 212 | 1 995 | 19 089 | 12 844 | 8 401 | 5 832 | 3 307 | 1 329 |
| 2016 | 19 901 | 19 492 | 14 117 | 9 182 | 6 672 | 4 389 | 2 123 | 19 541 | 13 970 | 8 836 | 5 986 | 3 457 | 1 417 |
| 2017 | 21 074 | 19 539 | 15 550 | 9 767 | 6 850 | 4 555 | 2 261 | 19 650 | 15 252 | 9 360 | 6 137 | 3 601 | 1 511 |
| 2018 | 22 548 | 19 402 | 17 011 | 10 473 | 7 059 | 4 714 | 2 407 | 19 602 | 16 557 | 9 990 | 6 309 | 3 740 | 1 607 |
| 2019 | 24 181 | 19 401 | 18 277 | 11 327 | 7 332 | 4 868 | 2 550 | 19 677 | 17 698 | 10 743 | 6 531 | 3 872 | 1 704 |
| 2020 | 25 862 | 19 786 | 19 197 | 12 347 | 7 700 | 5 024 | 2 689 | 20 099 | 18 548 | 11 629 | 6 832 | 4 002 | 1 797 |
| 2021 | 27 500 | 20 580 | 19 614 | 13 541 | 8 137 | 5 167 | 2 813 | 20 879 | 18 967 | 12 648 | 7 191 | 4 115 | 1 883 |
| 2022 | 29 155 | 21 762 | 19 637 | 14 910 | 8 658 | 5 315 | 2 932 | 22 004 | 19 054 | 13 807 | 7 623 | 4 227 | 1 967 |
| 2023 | 30 734 | 23 250 | 19 477 | 16 302 | 9 286 | 5 488 | 3 046 | 23 409 | 18 988 | 14 985 | 8 140 | 4 352 | 2 047 |
| 2024 | 32 120 | 24 896 | 19 454 | 17 502 | 10 047 | 5 711 | 3 157 | 24 974 | 19 044 | 16 010 | 8 758 | 4 513 | 2 125 |
| 2025 | 33 241 | 26 592 | 19 822 | 18 371 | 10 959 | 6 011 | 3 270 | 26 609 | 19 439 | 16 772 | 9 487 | 4 729 | 2 200 |
| 2026 | 33 974 | 28 241 | 20 601 | 18 759 | 12 029 | 6 365 | 3 376 | 28 226 | 20 180 | 17 145 | 10 329 | 4 987 | 2 266 |
| 2027 | 34 394 | 29 904 | 21 765 | 18 770 | 13 255 | 6 787 | 3 485 | 29 879 | 21 252 | 17 218 | 11 285 | 5 294 | 2 332 |
| 2028 | 34 481 | 31 484 | 23 231 | 18 609 | 14 500 | 7 292 | 3 611 | 31 463 | 22 591 | 17 156 | 12 256 | 5 662 | 2 406 |
| 2029 | 34 219 | 32 861 | 24 851 | 18 582 | 15 571 | 7 905 | 3 772 | 32 847 | 24 083 | 17 206 | 13 101 | 6 102 | 2 500 |
| 2030 | 33 633 | 33 956 | 26 512 | 18 925 | 16 342 | 8 637 | 3 982 | 33 940 | 25 637 | 17 562 | 13 726 | 6 621 | 2 627 |
| 2031 | 32 609 | 34 668 | 28 137 | 19 668 | 16 692 | 9 502 | 4 232 | 34 639 | 27 187 | 18 240 | 14 042 | 7 227 | 2 780 |
| 2032 | 31 264 | 35 061 | 29 774 | 20 777 | 16 708 | 10 493 | 4 525 | 35 013 | 28 772 | 19 216 | 14 114 | 7 916 | 2 962 |

*Sources*: calculated from World Population Prospects 2008 Revision and World Urbanization Prospects 2009 Revision, UN

Table 4.3 exhibits that the earnings are obviously different between male and female employees as well. The older the male workers, the more earnings for them when they are working in the occupation such as public organization sector, professional and techniques sector, production, transportation and operation sector. In contrast, when the female workers are getting older they will earn less if they work as clerks or workers in production, transportation and operation sector. Besides the gender earnings gap, the differences in earning level across cities is rather large compared to differences in earning level along other dimensions. To some extent, the females are over-represented among those of limited education, young adults (with short work experience), and occupations in low paying sectors. These are indicated as differences in variables.

Table 4.4 is concerned with the average pension benefits of male and female retirees. The presented pension benefits of male retirees are sorted by retirement age, education attainment, occupation segregation, and cities. The female pension benefits are measured as percentage of male pensions. These two data sets display a similar pattern of pension benefits for males and females. For both sexes later retirement can obtain more pension benefits because of longer working experience (pension contribution period). But the percentage of female pension benefits to male pension benefits declines along with the retirement age increasing. The higher the education level, the more pension benefits the retirees will get. That is because the pension benefits are relevant to the earnings before retirement and the education is an important element that determines the earnings level. Employees with higher education attainment are considered as with more human capital that they usually work in the occupations with a higher payment. The pension benefits vary among occupation segregations in an ascending order from production, transportation and operation workers to public organization officers. The difference of pension benefits across cities is also large. For an instance, the retirees in Shanghai have the most pension benefits while the retirees in Chongqing have the lowest. Although the pension benefits are highest in Shanghai, the smallest gender pension difference is in Beijing with a higher percentage of female pension benefits to males. The gender gap of pension benefits in Tianjin is the largest one.

**Table 4.3 Descriptive statistics of main variables by gender**

| | *1999* | | | | | *2008* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Male* | | *Female* | | Difference in mean | *Male* | | *Female* | | Difference in mean |
| *Continuous variables* | Mean | SD | Mean | SD | | Mean | SD | Mean | SD | |
| Retirement age | 59.40 | 2.77 | 53.99 | 2.74 | 5.41 | 58.76 | 2.67 | 54.01 | 2.70 | 4.74 |
| Work experience (*year)* | 39.46 | 2.19 | 35.09 | 1.98 | 4.37 | 39.36 | 2.50 | 35.54 | 1.87 | 3.81 |
| Earnings (*yuan*) | 25903 | 8581 | 21714 | 7270 | 4190 | 33874 | 15424 | 27823 | 12744 | 6052 |
| *Discrete variables* | % | | % | | Difference in % | % | | % | | Difference in % |
| Education attainment | | | | | | | | | | |
| Primary school | 19.15 | | 23.97 | | -4.82 | 15.05 | | 17.65 | | -2.60 |
| Junior school | 44.68 | | 43.03 | | 1.65 | 41.37 | | 41.02 | | 0.35 |
| Senior & Professional | 21.80 | | 19.44 | | 2.36 | 22.70 | | 21.81 | | 0.89 |
| University & College | 13.39 | | 12.75 | | 0.64 | 19.27 | | 18.20 | | 1.07 |
| Graduated and above | 0.98 | | 0.81 | | 0.17 | 1.61 | | 1.32 | | 0.29 |
| | 100 | | 100 | | 0 | 100 | | 100 | | 0 |
| Occupations | | | | | | | | | | |
| Public orgnization | 5.04 | | 2.11 | | 2.93 | 12.07 | | 6.48 | | 5.59 |
| Professional & technical | 10.42 | | 7.66 | | 2.76 | 17.43 | | 9.43 | | 8.00 |
| Clerks & workers | 16.11 | | 24.05 | | -7.94 | 24.70 | | 33.59 | | -8.88 |
| Business service | 23.38 | | 33.51 | | -10.13 | 22.27 | | 34.35 | | -12.08 |
| Production, transportation & operation workers | 45.05 | | 32.67 | | 12.38 | 23.53 | | 16.15 | | 7.38 |
| | 100 | | 100 | | 0 | 100 | | 100 | | 0 |

**Table 4.4 Average pension benefits of male and female retirees *(yuan)***

| | *1999* | | *2008* | |
|---|---|---|---|---|
| | Male | Female as % of male | Male | Female as % of male |
| *Retirement age* | | | | |
| 55-59 (50-54) | 18040 | 81.09 | 24053 | 85.14 |
| 60-64 (55-59) | 18658 | 75.57 | 24877 | 79.35 |
| *Education* | | | | |
| Primary school | 11135 | 74.45 | 14846 | 78.17 |
| Junior school | 15878 | 77.62 | 21171 | 81.50 |
| Senior school | 21069 | 80.25 | 28092 | 84.26 |
| University & college | 26448 | 81.69 | 35264 | 85.77 |
| Graduated & above | 34219 | 86.59 | 45625 | 90.92 |
| *Occupation* | | | | |
| Production, transportation & operation | 12993 | 66.92 | 17324 | 70.27 |
| Business service | 19003 | 70.62 | 25337 | 74.15 |
| Clerks & workers | 19919 | 73.20 | 26559 | 76.86 |
| Professional & technical | 20802 | 75.59 | 27736 | 79.37 |
| Public organization | 29959 | 79.05 | 39945 | 83.00 |
| *Cities* | | | | |
| Beijing | 21392 | 84.03 | 28523 | 88.23 |
| Shanghai | 21530 | 81.89 | 28707 | 85.98 |
| Chongqing | 13602 | 77.11 | 18136 | 80.97 |
| Guangzhou | 15642 | 75.52 | 20856 | 79.30 |
| Tianjin | 19225 | 72.95 | 25633 | 76.60 |

# PART V EMPIRICAL RESULTS

## 5.1 Results of Actuarial Model

The actuarial model has simulated the change of the gender difference in pension benefits for the next two decades, from 2011 to 2032. The female-male pension benefits ratios used as the results are displayed in Table 5.1, which in order to examine the pension gender gap over time. More to the point, a trend chart of the gender difference changes in pension benefits is drawn up in Figure 5.1.

Table 5.1 exhibits that, over the next 22 years, the gender pension gap of urban retirees in China will steadily increase since the values of female-male pension benefits ratio keep decreasing. At the level of a whole society, the overall female-male ratio of pension benefits will considerably reduce from 93.98% in 2011 to 77.81% in 2032. At an individual level, the average female-male ratio of pension benefits will diminish by about 10%, from 89.91% in 2011 to 80.28% in 2032. In the meantime, the mean values of the overall ratio and the average ratio in this study are 86.67% and 87.55%, respectively. Both of these two figures show that the estimated pension benefits level of female retirees is less than 88% of the male retirees' pension level, no matter from a social or an individual point of view.

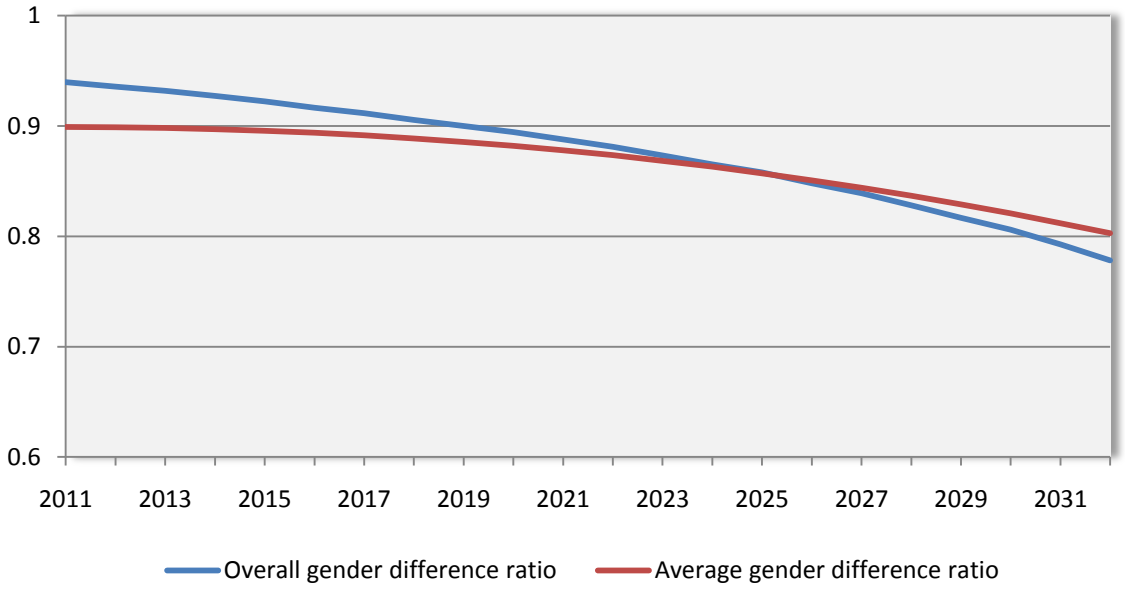
**Table 5.1 Gender difference ratio of pension benefits in 2011-2032**

| Female-male pension benefits ratio | | | | | |
|---|---|---|---|---|---|
| Retired year | Total ratio | Average ratio | Retired year | Total ratio | Average ratio |
| 2011 | 0.9398 | 0.8991 | 2022 | 0.8812 | 0.8735 |
| 2012 | 0.9358 | 0.8989 | 2023 | 0.8734 | 0.8686 |
| 2013 | 0.9319 | 0.8982 | 2024 | 0.8652 | 0.8631 |
| 2014 | 0.9274 | 0.8971 | 2025 | 0.8581 | 0.8572 |
| 2015 | 0.9223 | 0.8957 | 2026 | 0.8480 | 0.8509 |
| 2016 | 0.9165 | 0.8938 | 2027 | 0.8391 | 0.8440 |
| 2017 | 0.9116 | 0.8915 | 2028 | 0.8282 | 0.8367 |
| 2018 | 0.9057 | 0.8888 | 2029 | 0.8169 | 0.8290 |
| 2019 | 0.9000 | 0.8857 | 2030 | 0.8061 | 0.8207 |
| 2020 | 0.8946 | 0.8821 | 2031 | 0.7927 | 0.8120 |
| 2021 | 0.8879 | 0.8780 | 2032 | 0.7781 | 0.8028 |

From Figure 5.1, both the overall ratio (blue line) and the average ratio (red line) of female-male pension benefits are estimated to keep declining throughout the prediction interval. This

trend means that the female pension benefits level will become lower compared with the male's pension level, and the pension gender gap will be getting larger. The change of the overall ratio will be greater than the change of the average ratio. In particular, the overall ratio of female-male pension benefits is bigger than the average ratio between 2011 and 2025, and the difference will be narrowing gradually. Starting from 2026, the overall ratio will be smaller than the average ratio till the end of the prediction interval. This variation trend of female-male pension benefits ratio implys that the pension gender gap is not only a financial security problem for an individual after he/she retires, but will be also a serious problem of social security to a whole society as time goes by.

**Figure 5.1 Tendency of pension gender difference ratio from 2011 to 2032**




As mentioned in methodology part, the actuarial model is inspired by Zhang *et.al* (2007). However, I have found an exactly opposite result to the authors, who reported the pension gender gap in China will become smaller in the future. One explanation for the differences between both studies is that I select only the urban China employees in my research while Zhang *et.al* (2007) studied the employees in whole China. On the other hand, the differences in data selection and parameter definitions of both studies could be another explanation.

## 5.2 Results of Regression Model

The multiple regressions are generated by five major regions in China for urban employees within two sample years 1999 and 2008 separately. The results of multiple regression estimations are reported in Table 5.2 for 1999 and in Table 5.3 for 2008.

Table 5.2 contains information on the gender difference of pension benefits in 1999 for several breakdowns by five major regions, Beijing, Shanghai, Chongqing, Guangzhou, and Tianjin. The results show that most coefficient estimates have the expected signs and are statistically significant[26], and the $R^2$ values are modest in all regression models. The first sub-table in Table 5.2 is the result of the whole sample in 1999, which indicates that the female retirees' pension benefits generally is 81.09% of their male counterparts pension benefits, as the exponential function of gender coefficient in the standard model is 0.8109. When considering the variables of retirement age, work experience, earnings, education and occupations, the proportion of female pension benefits to male's increases to 90.57%, as the exponential function of gender coefficient is 0.9057 in the complete model. The remaining percentage 9.43% (1-0.9057) refers to the other factors which are not taken into account by the regression models in this study. The values of $\exp \beta_{gender}$ decrease most when the nested models exclude the variables of education and retirement age, respectively. This shows that education and retirement age account significant effect for explaining the reason of gender difference in pension benefits. As to the other variables, occupation has no impact on the pension gender gap.

Next, we look at the gender difference in pension benefits for breakdowns by region. The gender difference of pension benefits is smaller in Beijing and Shanghai. Their pension gender gaps in percentage are 7.68% (1-0.9232) for Beijing and 8.73% (1-0.9127) for Shanghai, respectively. The results in Table 5.2 by regions for 1999 show that Shanghai and Chongqing share the similar pattern with the whole sample where retirement age and education have a great effect on the gender pension gap, while occupation has no effect at all. Retirement age has a significant effect on gender difference of pensions in Beijing as well as in Tianjin. The only one exception is that work experience has an effect on gender difference in pension benefits, as

[26] See the regression results in Appendix 2.

important as retirement age in Guangzhou. This exception might because Guangzhou has particular policies as one of Special Economic Zones[27] in China.

The results of the multiple regressions estimation for 2008 are reported in Table 5.3. There are a number of similarities and differences in the results of 2008, compared to the results of 1999 in Table 5.2. Findings which are relevant to this study will be discussed in the followings. First, as the results of the whole sample in 2008, according to the values of $\exp \beta_{gender}$ , the female-male pension benefits ratio change from 79.48% in the standard model to 88.24% in the complete model. These numbers are lower in 2008 than those in 1999. It implies that the gender difference of pension benefits becomes larger, and the explanation proportion of the variables involved in the regression models for pension gender gap becomes minor. Second, similar to the results of 1999, retirement age and education have a significant effect on gender difference in pension benefits. Last but not the least, the results of each region is the same as the results of the whole sample in 2008 except for Shanghai. It is interesting to see that earnings and occupations also play an important role in affecting pension gender gap in Shanghai. As the financial center of China, in general, the wage level in Shanghai is noticeably higher than other cities and regions. Moreover, the wage levels in different occupations vary a lot. That might be the reasons why earnings and occupations both have a significant effect on gender difference of pension benefits in Shanghai.

### 5.3 Summary of the results

Under the current social security system and pension policies, the gender difference of pension benefits is significant in urban China. And this pension gender gap will be increasing during the following decades. Thus, the policy makers should pay more attention to this issue. The results in Table 5.2 and in Table 5.3 obviously show that retirement age and education are the two major factors, which have a significant effect on gender difference in pension benefits. This indicates that the recent two pension reforms in 1997 and 2005 have not reduced the gender difference of pensions, and have not affected the main factors, which have an effect on the gender pension gap.

[27] In China, Special Economic Zones (SEZ) were founded by the central government under *Xiaoping Deng* in the early 1980s. SEZ is a geographical region that has economic and other laws that are more free-market-oriented than a country's typical or national laws. "Nationwide" laws may be suspended inside a special economic zone.

**Table 5.2 Key indicators of multiple regressions and results by region 1999**

Recalling from section 3.2.1, there are three steps in the multiple regression analysis which generate seven models in total. In each sub-table below, model (1) is a standard model only containing gender variable; model (2) is a complete model, including other five variables (retirement age, work experience, earnings, education, and occupation) besides gender variable; model (3) - (7) are five nested models, and each nested model exclude one of the five variables, respectively. $\beta_{gender}$ is a coefficient of gender variable, and $\exp \beta_{gender}$ represents an average female-male pension benefits ratio in each regression model. $R^2$ is the coefficient of determination of each regression model.

**Total**

| Model | Adjusted $R^2$ | $\beta_{gender}$ | Exp($\beta_{gender}$) |
|---|---|---|---|
| (1) Standard | 0.0859 | -0.2096 | 0.8109 |
| (2) Complete | 0.5935 | -0.0991 | 0.9057 |
| (3) Retirement_age excluded | 0.5525 | -0.1606 | 0.8516 |
| (4) Work_experience excluded | 0.5504 | -0.1195 | 0.8874 |
| (5) Earnings excluded | 0.4867 | -0.1699 | 0.8437 |
| (6) Education excluded | 0.5180 | -0.2096 | 0.8109 |
| (7) Occupation excluded | 0.5061 | -0.0991 | 0.9057 |

**Beijing**

| Model | Adjusted $R^2$ | $\beta_{gender}$ | Exp($\beta_{gender}$) |
|---|---|---|---|
| (1) Standard | 0.1128 | -0.1700 | 0.8437 |
| (2) Complete | 0.6907 | -0.0800 | 0.9232 |
| (3) Retirement_age excluded | 0.6097 | -0.1396 | 0.8697 |
| (4) Work_experience excluded | 0.6714 | -0.1195 | 0.8873 |
| (5) Earnings excluded | 0.6907 | -0.0854 | 0.9181 |
| (6) Education excluded | 0.6790 | -0.1377 | 0.8714 |
| (7) Occupation excluded | 0.5841 | -0.1158 | 0.8907 |

**Shanghai**

| Model | Adjusted $R^2$ | $\beta_{gender}$ | Exp($\beta_{gender}$) |
|---|---|---|---|
| (1) Standard | 0.04092 | -0.1726 | 0.8415 |
| (2) Complete | 0.6469 | -0.0913 | 0.9127 |
| (3) Retirement_age excluded | 0.649954 | -0.1480 | 0.8625 |
| (4) Work_experience excluded | 0.6437 | -0.0978 | 0.9068 |
| (5) Earnings excluded | 0.649666 | -0.1169 | 0.8897 |
| (6) Education excluded | 0.56317 | -0.1633 | 0.8493 |
| Occupation excluded | 0.48188 | -0.0814 | 0.9218 |

**Chongqing**

| Model | Adjusted $R^2$ | $\beta_{gender}$ | Exp($\beta_{gender}$) |
|---|---|---|---|
| (1) Standard | 0.03414 | -0.2328 | 0.7923 |
| (2) Complete | 0.682385 | -0.1437 | 0.8661 |
| (3) Retirement_age excluded | 0.68242 | -0.2147 | 0.8068 |
| (4) Work_experience excluded | 0.68646 | -0.1619 | 0.8505 |
| (5) Earnings excluded | 0.641343 | -0.1657 | 0.8473 |
| (6) Education excluded | 0.65299 | -0.1734 | 0.8408 |
| (7) Occupation excluded | 0.63778 | -0.1369 | 0.8721 |

**Guangzhou**

| Model | Adjusted $R^2$ | $\beta_{gender}$ | Exp($\beta_{gender}$) |
|---|---|---|---|
| (1) Standard | 0.154492 | -0.2199 | 0.8026 |
| (2) Complete | 0.706535 | -0.1309 | 0.8773 |
| (3) Retirement_age excluded | 0.702207 | -0.1947 | 0.8231 |
| (4) Work_experience excluded | 0.68884 | -0.1809 | 0.8345 |
| (5) Earnings excluded | 0.70854 | -0.1525 | 0.8586 |
| (6) Education excluded | 0.70758 | -0.1415 | 0.8681 |
| (7) Occupation excluded | 0.60897 | -0.1550 | 0.8564 |

**Tianjin**

| Model | Adjusted $R^2$ | $\beta_{gender}$ | Exp($\beta_{gender}$) |
|---|---|---|---|
| (1) Standard | 0.52907 | -0.2237 | 0.7996 |
| (2) Complete | 0.77896 | -0.1351 | 0.8736 |
| (3) Retirement_age excluded | 0.773207 | -0.2058 | 0.8140 |
| (4) Work_experience excluded | 0.75488 | -0.1701 | 0.8436 |
| (5) Earnings excluded | 0.698576 | -0.1421 | 0.8676 |
| (6) Education excluded | 0.75467 | -0.1748 | 0.8396 |
| (7) Occupation excluded | 0.74517 | -0.1540 | 0.8573 |

**Table 5.3 Key indicators of multiple regressions and results by regions 2008**

Recalling from section 3.2.1, there are three steps in the multiple regression analysis which generate seven models in total. In each sub-table below, model (1) is a standard model only containing gender variable; model (2) is a complete model, including other five variables (retirement age, work experience, earnings, education, and occupation) besides gender variable; model (3) - (7) are five nested models, and each nested model exclude one of the five variables, respectively. $\beta_{gender}$ is a coefficient of gender variable, and $\exp \beta_{gender}$ represents an average female-male pension benefits ratio in each regression model. $R^2$ is the coefficient of determination of each regression model.

**Total**

| Model | Adjusted $R^2$ | $\beta_{gender}$ | Exp($\beta_{gender}$) |
|---|---|---|---|
| (1) Standard | 0.0286 | -0.2297 | 0.7948 |
| (2) Complete | 0.5373 | -0.1251 | 0.8824 |
| (3) Retirement_age excluded | 0.5282 | -0.2001 | 0.81865 |
| (4) Work_experience excluded | 0.5345 | -0.1716 | 0.84232 |
| (5) Earnings excluded | 0.4190 | -0.1958 | 0.82217 |
| (6) Education excluded | 0.5009 | -0.2127 | 0.80837 |
| (7) Occupation excluded | 0.5178 | -0.1461 | 0.86405 |

**Beijing**

| Model | Adjusted $R^2$ | $\beta_{gender}$ | Exp($\beta_{gender}$) |
|---|---|---|---|
| (1) Standard | 0.0029 | -0.1713 | 0.8426 |
| (2) Complete | 0.3996 | -0.1074 | 0.8982 |
| (3) Retirement_age excluded | 0.4041 | -0.1556 | 0.8559 |
| (4) Work_experience excluded | 0.3938 | -0.1392 | 0.8701 |
| (5) Earnings excluded | 0.3541 | -0.1354 | 0.8734 |
| (6) Education excluded | 0.3746 | -0.1694 | 0.8442 |
| (7) Occupation excluded | 0.3858 | -0.1238 | 0.8836 |

**Shanghai**

| Model | Adjusted $R^2$ | $\beta_{gender}$ | Exp($\beta_{gender}$) |
|---|---|---|---|
| (1) Standard | 0.0003 | -0.1691 | 0.8444 |
| (2) Complete | 0.4300 | -0.0856 | 0.9180 |
| (3) Retirement_age excluded | 0.4331 | -0.1629 | 0.8497 |
| (4) Work_experience excluded | 0.4329 | -0.1338 | 0.8747 |
| (5) Earnings excluded | 0.3169 | -0.2165 | 0.8053 |
| (6) Education excluded | 0.4020 | -0.1539 | 0.8574 |
| (7) Occupation excluded | 0.3704 | -0.1669 | 0.8463 |

**Chongqing**

| Model | Adjusted $R^2$ | $\beta_{gender}$ | Exp($\beta_{gender}$) |
|---|---|---|---|
| (1) Standard | 0.0793 | -0.3528 | 0.7027 |
| (2) Complete | 0.6053 | -0.2248 | 0.7987 |
| (3) Retirement_age excluded | 0.6048 | -0.2490 | 0.7796 |
| (4) Work_experience excluded | 0.6080 | -0.1967 | 0.8215 |
| (5) Earnings excluded | 0.6027 | -0.1840 | 0.8319 |
| (6) Education excluded | 0.5585 | -0.2090 | 0.8114 |
| (7) Occupation excluded | 0.5133 | 0.1025 | 1.1079 |

**Guangzhou**

| Model | Adjusted $R^2$ | $\beta_{gender}$ | Exp($\beta_{gender}$) |
|---|---|---|---|
| (1) Standard | 0.0841 | -0.3092 | 0.7340 |
| (2) Complete | 0.5845 | -0.2107 | 0.8100 |
| (3) Retirement_age excluded | 0.5518 | -0.3015 | 0.7397 |
| (4) Work_experience excluded | 0.5852 | -0.2497 | 0.7791 |
| (5) Earnings excluded | 0.5018 | -0.2714 | 0.7623 |
| (6) Education excluded | 0.5540 | -0.2841 | 0.7527 |
| (7) Occupation excluded | 0.5561 | -0.2384 | 0.7879 |

**Tianjin**

| Model | Adjusted $R^2$ | $\beta_{gender}$ | Exp($\beta_{gender}$) |
|---|---|---|---|
| (1) Standard | 0.0690 | -0.2451 | 0.7827 |
| (2) Complete | 0.4435 | -0.1792 | 0.8359 |
| (3) Retirement_age excluded | 0.4469 | -0.2208 | 0.8019 |
| (4) Work_experience excluded | 0.4502 | -0.1657 | 0.8473 |
| (5) Earnings excluded | 0.4469 | -0.1888 | 0.8279 |
| (6) Education excluded | 0.2668 | -0.2012 | 0.8177 |
| (7) Occupation excluded | 0.3564 | -0.1539 | 0.8573 |

## PART VI CONCLUSION AND IMPLICATIONS

This study focuses on the gender difference in pension benefits between female and male employees in urban China within the present pension system. The results of the actuarial model reveal that there is a significant gender difference of pension benefits for the urban Chinese retirees, and this pension gender difference will increasingly expand in the next two decades. It also predicts that the pension level of female retirees will reduce to less than 80% of the male pension benefits level in 2032. The enlarging pension gender gap in urban China means a lack of financial protection for female urban retirees to maintain their basic living standard after they retire.

The results of the multiple regressions clearly confirm that the female employees are treated unequally in terms of retirement age as well as education attainment. Females usually retire earlier than their male counterparts, partly due to a five-year difference in the legal retirement ages for men and women in China. For example, a male and a female employee take part in the labor market at the same age but retire at ages with a five-year difference that will inevitably lead to a gender difference in pension benefits. Moreover, women have a longer life expectancy than men so that female retirees need to receive much more pension income for keeping the basic living standard after their retirement. Therefore, the uniform retirement age of both gender groups is one of the useful practices to reduce the pension gender gap, because increasing the retirement age of female employees will extend their pension contribution period. On the other hand, later retirement age for females will shorten their lifespan after retirement.

The results also imply that education has a significant effect on gender difference in pension benefits. The unequal treatment against females in education attainment in urban China is caused by family preferences for educational investment for boys over girls. When budget constraints become tight, Chinese families tend to cut expenditure on girls' education. This result is consistent with the previous findings by Cai and Wang (2001). For narrowing the pension gender gap, the government intervention is also needed to ensure equal access to education for both females and males.

In addition, the gender difference of pension benefits may also has contributed to the other factors besides retirement age, work experience, earnings, education attainment and occupations

in this study. Policy makers can also reduce the pension gender gap through other aspects when they are making a new pension system. For instance, the government could consider setting up an adjusted pension payment for female retirees so as to compensate their pension gender gap. Increasing female employment in the labor market or decreasing the minimum contribution years to be entitled to receive pension benefits are both effective ways to lessen the pension gender gap.

As a conclusion, the findings of this paper provide some insights for both Chinese policy makers and future research on China's social security reform. To narrow the pension gender gap, the Chinese government should seek to address the best way of achieving financial security, especially for female retirees, so that both the individual and society will benefit. From an individual perspective, the adequate pension provisions will meet the basic needs of female retirees when they grow older and older. As to a society perspective, social sustainability and harmony will be strengthened if essential support for both male and female growing elderly can be guaranteed.

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## APPENDIX 1 BASIC PENSION BENEFITS POLICIES IN 1997 AND 2005

### 1A Basic pension insurance calculation designed in 1997

In 1997, the Chinese State Council issued a Document No.26 on *Decision on Establishing a Unified Basic Pension system for Enterprise Employees*, detailing the establishment of an old age security system by implementing a social-pooling funds plus individual accounts scheme. The basic old-age insurance system for enterprise employees involves the following policies:

- a basic insurance premium jointly paid by enterprises and employees.
- the enterprise share generally not exceed 20% of their total wage bill.
- employees pay 8% of their wages.
- all the payments are going to employees personal accounts.
- the self-employed and those in flexible employment in urban areas pay premiums equal to 20% of the local average wage. (not involved in this paper)
- the individual account is 11% of the employee's wage.
- enterprise employees have to accumulate at least 15 years contributions to be entitled to receive a monthly basic pension benefits when they reach the legal retirement age.
- the monthly base pension for an employee is 20% of social monthly average wage.
- the monthly pension disbursed from an employee's personal account equals the cumulative savings in this account divided by 120 months.

The Chinese version: *http://www.sdpc.gov.cn/jyysr/zcfg/t20050714_35691.htm*

### 1B Revised pension calculation in 2005

On 3rd December, 2005, the Chinese government promulgated a State Council Document No. 38 on *Strengthening Pension Reform for Enterprise Employees*. It was formulated after pilot programs had been carried out in the Northeast provinces. Document No. 38 further reforms the formula of pension benefits that is characterized by tightening links to years of contributions. Comparing with the old pension calculated method, the revised calculation scheme made several changes below:

- the individual account was downsized from 11% to 8% of the employee's wage level.
- the monthly base pension was directly linked to employee's contribution years instead of 20% of local monthly average wage, with 1% for every full year of contributions.
- the monthly pension disbursed from an individual account was changed to the cumulative savings in the account divided by the number of months for pension payment. The months were based on the average left lifespan of urban employees at the time when they retire.
- the current policy is that employees who retire at 60 get 139 months of pension payment.
- the state also adjusts the basic pension level with reference to wage increases and price indexation based on the urban cost of living.

According to these policies, the new formula of the base pension is,

$$\textit{monthly base pension} = \frac{\textit{previous year's monthly average wage for employees in local area} + \textit{average personal indexed monthly wage for}}{2} \times \frac{\textit{total full years of contributions}}{100}$$

## APPENDIX 2 RESULTS OF MULTIPLE REGRESSIONS

### 2A Results of multiple regressions 1999

| Variables | | Models | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Constant | | 8.699 | 7.092 | 7.164 | 5.734 | 10.501 | 6.465 | 5.176 |
| | | (274.262) | (7.363) | (7.415) | (7.189) | (11.236) | (6.727) | (5.980) |
| Retirement_age | | | 0.031** | | 0.103** | 0.023** | 0.043** | 0.052** |
| | | | (2.031) | | (2.271) | (2.435) | (2.801) | (3.506) |
| Work_experience | | | 0.077 | -0.030 | | 0.069* | 0.092** | 0.070 |
| | | | (2.483) | (1.449) | | (2.045) | (2.845) | (2.140) |
| 8Earnings | | | 0.362* | 0.322* | 0.323* | | 0.384* | 0.348* |
| | | | (8.228) | (8.092) | (8.098) | | (10.132) | (8.573) |
| Education | Primary | | 0.133** | 0.189** | 0.175** | 0.491** | | -0.147 |
| | | | (2.712) | (2.001) | (1.923) | (2.472) | | (1.754) |
| | Junior | | 0.069** | 0.024** | 0.033 | 0.216** | | -0.111 |
| | | | (2.376) | (2.130) | (1.180) | (1.108) | | (1.587) |
| | Senior | | 0.214* | -0.175 | -0.183 | 0.033** | | -0.293** |
| | | | (3.700) | (1.959) | (1.997) | (2.168) | | (2.564) |
| | University | | 0.157 | 0.128 | 0.136** | 0.036 | | -0.216** |
| | | | (1.876) | (1.714) | (2.757) | (1.186) | | (2.169) |
| Occupations | Worker | | -0.319*** | -0.380*** | -0.303** | -0.498*** | -0.396** | |
| | | | (3.112) | (3.849) | (2.939) | (4.622) | (3.841) | |
| | Clerk | | -0.064** | -0.014 | -0.049 | -0.198** | -0.098* | |
| | | | (2.697) | (1.150) | (1.529) | (2.031) | (2.072) | |
| | Business | | 0.075 | 0.039 | -0.076 | -0.068 | 0.116 | |
| | | | (0.069) | (0.450) | (1.864) | (1.730) | (1.307) | |
| | professional | | 0.089 | 0.199* | 0.085* | 0.172 | 0.036 | |
| | | | (2.080) | (3.099) | (-2.016) | (1.944) | (1.428) | |

a. Model (1) is a standard regression model with only gender variable. Model (2) is a complete model with other five variables (retirement age, work experience, earnings, education, and occupations) besides gender variable. Model (3) – (7) are nested models, which exclude retirement age, work experience, earnings, education, and occupations, respectively.
b. The education dummy variable contains 5 categories, and the occupations dummy variable contains 5 categories as well. All regressions also include controls to region (Beijing, Shanghai, Chongqing, Guangzhou, Tianjin).
c. The parameter estimates represent the effect of a one unit change in the independent variable on the variation of pension benefits.
d. Column 5 is the result using annual earnings in logarithm.
e. Sample observation is 4408 in total, which include 2287 of males and 2121 of females, respectively.
f. T-statistics are in parentheses, and all errors are heteroskedasticity robust.
g. ***, **, and * indicate 1%, 5%, and 10% significance levels, respectively.

**2B Results of multiple regressions 2008**

| Variables | | Models | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Constant | | 7.382 | 5.028 | 5.170 | 4.699 | 9.519 | 3.518 | 4.072 |
| | | (130.844) | (9.685) | (9.888) | (9.420) | (21.989) | (7.144) | (8.617) |
| Retirement_age | | | 0.037** | | 0.019** | 0.051** | 0.024** | 0.024** |
| | | | (3.724) | | (3.337) | (4.582) | (2.359) | (2.571) |
| Work_experience | | | 0.064* | 0.012 | | -0.039* | -0.015 | -0.005 |
| | | | (2.212) | (1.479) | | (2.372) | (1.005) | (0.446) |
| Earnings | | | 0.458* | 0.472* | 0.416* | | 0.576* | 0.503* |
| | | | (12.948) | (13.291) | (12.993) | | (17.706) | (14.401) |
| Education | Primary | | -0.705** | -0.625 | -0.670** | -1.100** | | -0.642** |
| | | | (4.894) | (4.346) | (4.667) | (6.972) | | (4.420) |
| | Junior | | -0.542** | -0.495** | -0.526** | -0.770*** | | -0.491** |
| | | | (3.949) | (3.587) | (3.828) | (5.051) | | (3.549) |
| | Senior | | 0.412*** | 0.371** | 0.400** | -0.540** | | 0.352** |
| | | | (3.000) | (2.681) | (2.903) | (3.516) | | (2.534) |
| | University | | 0.251 | 0.214 | 0.241 | 0.248 | | 0.207 |
| | | | (1.840) | (1.558) | (1.763) | (1.626) | | (1.491) |
| Occupations | Worker | | -0.230** | -0.111 | -0.128 | -0.431** | -0.363** | |
| | | | (2.563) | (1.315) | (1.655) | (4.350) | (4.065) | |
| | Clerk | | -0.187** | -0.101 | -0.133 | -0.297** | -0.279** | |
| | | | (2.370) | (1.331) | (1.578) | (3.378) | (3.558) | |
| | Business | | 0.030 | 0.080 | 0.072 | 0.007 | -0.084 | |
| | | | (0.404) | (1.071) | (0.993) | (0.089) | (1.132) | |
| | professional | | 0.181* | 0.148* | 0.157* | 0.313* | 0.203* | |
| | | | (2.467) | (2.011) | (2.167) | (3.860) | (2.701) | |

a. Model (1) is a standard regression model with only gender variable. Model (2) is a complete model with other five variables (retirement age, work experience, earnings, education, and occupations) besides gender variable. Model (3) – (7) are nested models, which exclude retirement age, work experience, earnings, education, and occupations, respectively.
b. The education dummy variable contains 5 categories, and the occupations dummy variable contains 5 categories as well. All regressions also include controls to region (Beijing, Shanghai, Chongqing, Guangzhou, Tianjin).
c. The parameter estimates represent the effect of a one unit change in the independent variable on the variation of pension benefits.
d. Column 5 is the result using annual earnings in logarithm.
e. Sample observation is 6080 in total, which include 3058 of males and 3022 of females, respectively.
f. T-statistics are in parentheses, and all errors are heteroskedasticity robust.
g. ***, **, and * indicate 1%, 5%, and 10% significance levels, respectively.