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The Impact of National Pension Reform on Labor

Conditions in Taiwan

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The Impact of National Pension Reform on Labor Conditions in Taiwan

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Abstract

This study examines the impact of the 2018 pension reform on the labor conditions in Taiwan using the DID empirical model. The database adopts the Accounting Office of the Executive Yuan's human resources utilization survey from 2015 to 2020. The empirical analysis reveals that the 2018 reform had a significant impact on working hours, leading to an increase in the number of retirees and subsequent hiring of new personnel. As a result, the existing workforce experienced an increase in working hours, highlighting the labor market implications of the reform.

Regression analysis further identifies education, gender, age, and marital status as significant factors influencing working hours, providing valuable insights into the determinants of labor dynamics following pension reforms. In terms of monthly wages, the 2018 reform was found to have a significant decreasing effect, while the 2011 reform did not produce a significant impact. Stricter eligibility criteria and reduced retirement benefits resulted in lower monthly wages. The regression analysis indicates that education, age, marital status, sex, major, and primary job significantly influence monthly wages, underscoring the importance of considering these demographic and occupational factors in wage dynamics. These findings contribute to a better understanding of the effects of pension reforms on employment and wages.

Keywords: 2018 pension reform, DID empirical model, working hour, monthly wage

摘要

本研究旨在探討 2018 年的年金改革對台灣勞動條件的影響,使用了 2015 至 2020 年行政院主計處人力資源運用調查中的資料進行差異中之差異法(DID)的實證模型。經實證分析發現,2018 年的改革對工時產生了顯著影響,進而導致退休人數增加。因此,現有員工的工時增加,彰顯了改革對勞動市場的影響。

進一步的回歸分析證實,教育、性別、年齡和婚姻狀況等因素對工時的影響同樣顯著,這為年金改革後勞動市場動態的決定因素提供了重要見解。每月薪資方面,研究發現 2018 年的改革有明顯的下降現象,而 2011 年的改革則未產生顯著影響。較嚴格的資格標準和減少的退休福利導致了每月薪資的減少。

迴歸分析指出教育、年齡、婚姻狀況、性別、專業以及主要職業對每月薪資有顯著影響,突顯了考慮這些人口和職業因素在薪資動態中的重要性。這些發現有助於更深入地了解年金改革對整體勞動市場就業和薪資的影響。

關鍵字: 2018 年金改革、DID 實證模型、工作時數、每月薪資

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1. Introduction

1.1 Background& Motivation

A longer average life expectancy in Taiwan's population compared to that of other countries is causing a decline in the working population there, resulting in things such as labor shortages and a decline in the working population. To ensure the retirement economic life of Chinese people in old age as a result of this situation, governments in various countries have established a pension system in order to address this problem.

The pension system can be differentiated in a number of different ways. In terms of ownership, it can be divided into two types: defined benefit systems and defined contribution systems. The former is that the government will guarantee that you will receive a fixed amount of pension after retirement regardless of how much you save before retirement. To guarantee that every person receives minimal economic security for the elderly, Taiwan's public insurance, labor insurance, military insurance, and national annuity insurance utilize this type of approach. The latter implies that the amount of money a person will receive upon retirement will be determined by how much they have saved, as well as the rate at which they are able to generate a return on their investment. As a pay-as-you-go service, the government will not subsidize a set amount because it will be a pay-as-you-go system. This method is applied by my country's new labor pension system. The new labor pension system, which was implemented in 2005, is also a defined contribution system. These two types of retirement systems each have their own set of advantages and disadvantages. The purpose of a defined benefit system is not just to protect employee incomes after retirement, but also to consider social appropriateness and distribute income in the most efficient way for the government. However, there are financial risks such as

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increased burden rates and insufficient reserves for the government, as well as the possibility of reforms. As the population ages, the financial burden will become heavier in the medium to long term. The defined contribution system has the advantage that the financial resources of the pension are allocated jointly by the employer and the employee, and there will be no significant changes with the change in population structure; the disadvantage is that it lacks economic security for the elderly.

Besides, it can be categorized into three types based on the financial processing method: pay-as-you-go, fully funded, and partially funded. The pay-as-you-go system refers to the direct payment of current financial source income to retiree pensions, with no additional asset allocation, investment, or transfer processes. In the years prior to 1995, our country's pension system for soldiers, civil servants, and public school teachers was a system that was pay-as-you-go. The full deposit reserve system requires that the pension be fully deposited in advance to ensure the fund's stability; the partial deposit reserve system falls somewhere between the pay-as-you-go system and the full deposit reserve system; there is no need to worry that someone will not be able to get the money back after retirement. It is the deposit and withdrawal preparation system that lies between the two. Normally, the primary focus is on deposit and withdrawal reserves, which are supplemented by pay-as-you-go, which means that the fund maintains a certain level of safety reserves, but if the fund is insufficient to pay, the pay-as-you-go system launches.

According to the simple life table released by the Ministry of the Interior in 2021, the average life expectancy of Chinese people is 80.86 years, with men having a life expectancy of 77.67 years and women having a life expectancy of 84.25 years, which is 7.5 years higher than the global average life expectancy of men and 9.25 years higher than the global average life expectancy of women. Other neighboring countries,

such as Japan and South Korea, have average life expectancies of 84.7 and 83.5 years, respectively, which are both higher than the OECD average of 80.5 years. In addition, Taiwan entered the aging society in 1993; it will continue to age in 2018; and it is anticipated that it will enter the super aging society in 2025[1], according to statistics from the National Development Commission. It is interesting to note that Taiwan moved from having an elderly society to having a super-aged society in just 7 years. It took the developed nations in Europe and the US longer than 50 years to adapt to the changes in the social demographic structure of the country as opposed to developed nations in Europe and the US[2]. In Taiwan, the elderly face an even greater challenge given the short amount of time they have to prepare for this shock as compared to other nations (Wang, J. L.,et al,2019). The working-age population[3] in Taiwan will make up 70.8% of the entire population in 2021, according to statistics from the Ministry of the Interior; Japan, South Korea, and the United States will be at 59.4%, 71.4%, and 64.9% respectively. Furthermore, by 2021, Taiwan's elderly population over 65 will comprise 16.9% of the total population, compared to 28.9% in Japan, 16.8% in South Korea, and 16.8% in the United States. The data in Figure 1 shows that between 1985 and 2021, the labor force participation rate in Taiwan ranged from 55 to 60 percent, with the exception of the four years during which the rate were higher than 60 percent from 1986 to 1989. As opposed to Japan, where the labor force participation rate is declining year over year, South Korea's labor force participation rate is rising. The United States has the highest labor force participation rate among

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[1] The World Health Organization (WHO) defines an aging society as one where more than 7% of the population is over 65; an aged society is one where 14% of the population is over 65; and a super-aged society is one where 20% of the population is over 65 years old

[2] According to estimates, it takes 11 years for Japan, 14 years for the United States, 29 years for France, and 51 years for the United Kingdom to transition from an aging society to a super-aged society, which is much longer than Taiwan's conversion period.

[3] The total population can be divided into three stages based on age: 0 to 14 years old, 15 to 64 years old, and 65 and older. The term "working-age population" generally refers to people between the ages of 15 and 64. 。

these nations, despite the fact that it is also trending downward year over year.
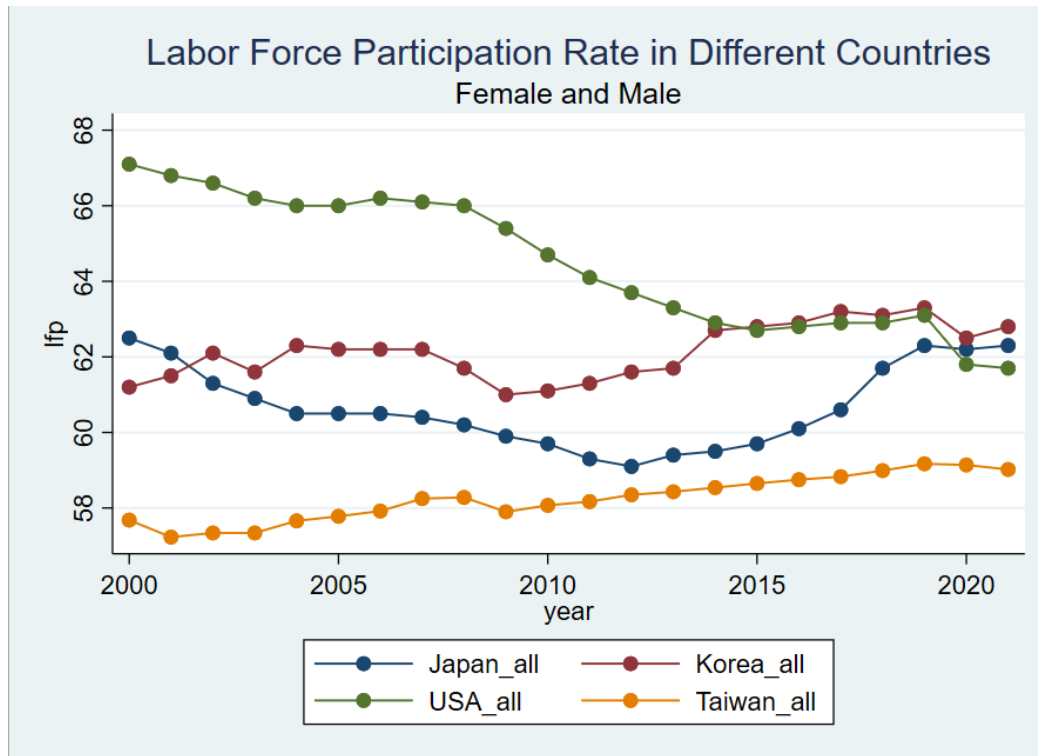
Figure1 Labor Participation Rate in Different Countries (Female and Male)

Source The Organization for Economic Cooperation and Development (OECD), Ministry of Labor, This study

Due to Taiwan's aging population and declining birthrate, the future workforce will shrink and the number of elderly retirees will rise, which will put a greater financial strain on the government and the current workforce. Therefore, the financial system is in need of reform in order to give people access to a comfortable as well as a stable economic retirement. For those in the labor force who must retire due to reaching retirement age or being unable to work due to other circumstances, the pension system offers security for their old age. In order to address the issue of population aging, the World Bank proposed a three-pillar model old-age pension system in its report "Averting the Old-Age Crisis" in 1994. The state-guarantee pension[4] is listed in the

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[4] The state guarantee annuity is also known as the public pension. Typically, this type of annuity plan uses a flat-rate national annuity paid by tax or a pay-as-you-go salary-related annuity.

first pillar. The second pillar is the occupational pension[5] and the third pillar is the private pension[6]. The World Bank put forth the " Old Age Income Support in the 21st Century: An International Perspective on Pension Systems and Reform " proposal in 2005, which expanded the three-pillar model to a five-pillar model and added the zeroth-pillar social assistance to provide the minimum of living security for the poor and the elderly. Furthermore, it also adds in the non-financial support[7] in the fourth pillar.

Taiwan's civil service has undergone numerous reforms since it was put into place in 1995, each with a specific objective. Two of the reforms, carried out in 2005 and 2018, had a respectable impact. The pension system for public employees in Taiwan was changed to a "contributory system" in 2005 as part of a pension reform. Assign a portion of the money so that the public employees can build up their own pensions and receive pensions when they retire. Furthermore, the retirement age for public servants has been raised from 60 to 65 years old. The "Public Servant Retirement Salary and Compensation Law" was officially passed by the Civil Service Reform on August 9, 2017, and it became effective in 2018. On November 21, 2018, the "Public Servant Retirement Law" and "Public Servant Compensation Law" were also abolished by the Ministry of Civil Services. The primary goals of the plan are to eliminate the preferential deposits made by civil servants[8], raise the starting age for monthly pensions[9], lower the income replacement rate[10], change how pensions are

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[5] An occupational annuity is a type of group retirement insurance that employers help their employees manage.

[6] Individuals can purchase private annuity insurance in the insurance market that best fits their financial situation and economic circumstances.

[7] Non-financial support includes family support, health care programs, long-term care programs, senior housing programs, and so on.

[8] The 18% premium deposit rate will return to zero after 2.5 years for retired public and educational employees who receive monthly pensions (including concurrent claims) and the total amount is greater than the minimum guaranteed amount (the premium deposit rate will decrease to 9% in 2020 and 2021 to 0%)

[9] The starting age for receiving a monthly pension is gradually raised, and it is put off to 65 years of age each year.

calculated at first[11], increase the allocation rate[12], etc., reduce pensions for civil servants, and stricken the rules for when they can retire.

Taiwan has implemented a number of pension reforms that have had an impact at many levels, including the national and individual economic levels. Meanwhile, the focus of this study will be specifically on the labor conditions in Taiwan. Figure 2 shows that between 1980 and 2021, the labor force participation rate for Taiwanese women increased annually from 39.25% to 51.49%, while the rate for Taiwanese men decreased annually from 77.11% in 1980 to to 66.93% in 2021 as shown in the figure.
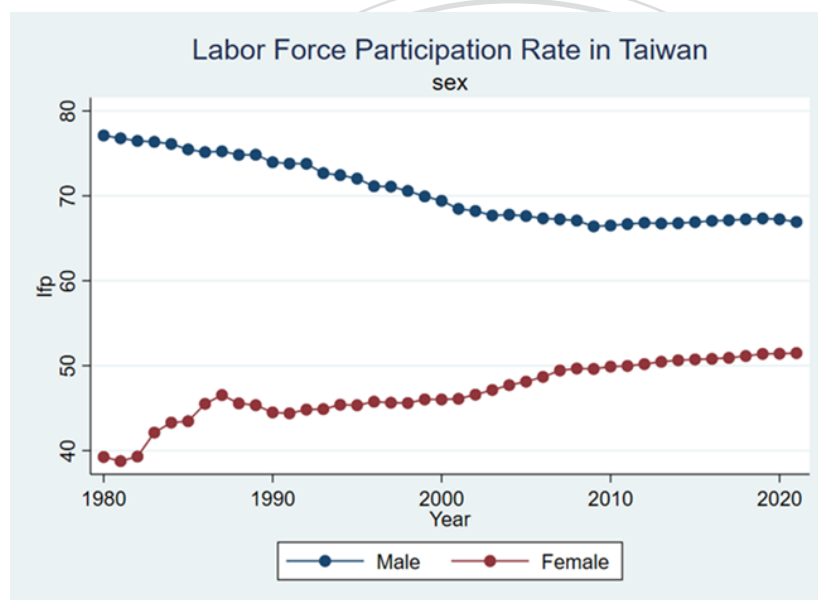
Figure 2 Labor Force Participation Rate on Sex in Taiwan

Source Ministry of Labor, This study

Recent researches and literatures mainly focus the finance and law aspects on the retirement reform. However, the impact of the retirement system reform covers a wide

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[10] The approved annuity system reform plan states that the income replacement rate for public and educational employees will drop from 75% to 60% in 10 years (using a 35-year example).

[11]After 2029, the "average salary amount of the last five years before the last job" will be extended by one year and will be replaced with "the average salary amount of the last 15 years before the last job" as the basis for calculating pensions for public servants.

[12]The current contribution rate is 12% of the basic salary of civil and educational employees, which is twice that amount of the public servants' salary. This law amendment has adjusted the statutory contribution to 12%-18%. The government share to individual share remains 65%:35%.

range of aspects, including gender, age, personal consumption, savings preferences, labor force in the labor market, labor participation rate, willingness of engaging in the labor market and government budget, etc. The pension reform will also have an impact on the labor market. By sharing the burden of pensions of retirees with their working counterparts who are still in the labor market, the working population will be faced with an increased financial burden that is bound to affect their working hours, their wages, and even their willingness to participate in the labor market in the future.

As it will be borne by the government, it will put additional financial strain on the government as it will have to bear the burden. The consequence of this is that pension systems with varying levels of financial resources should be able to achieve reform in a variety of ways, regardless of their levels of financial resources. At the same time, it is necessary to consider and discuss different factors related to the pension system at a variety of levels, and to also evaluate the impact of the reformation of the retirement system on the individual as well. A large majority of the current literatures on public servant pensions in Taiwan focuses largely on the legal system and the changes in system design. However, little research has been conducted on the impact of those changes. In order to better understand how the reform of Taiwan's public service retirement system will affect the labor conditions in the labor market in the future, this research will consider factors such as gender age, education level, major, living regions as well as investigate the impact of the National Pension Reform on the labor conditions in Taiwan.

2. Literature Review

Laborers are the priority for application in Taiwan's overall annuity system development. Taiwan has implemented numerous reforms and plans for its national pension, and other social insurance payment annuity systems are also under

refinement. Taiwan's pension system is one of them, and it is quite complicated.

The reform of the pension system will affect wages and working hours in the labor market. On the labor demand side, when companies provide retirement pensions to employees, it will slow down the growth rate of their wages, shifting some of the burden to the employees. Additionally, companies may reduce the number of new hires or take other measures to cut personnel expenses, indirectly leading to an increase in employees' working hours. Therefore, the pension system reform will have an impact on employees' working hours and wages.

This chapter aims to examine the current National Pension System in Taiwan and provide a concise introduction to the disparities between the reforms implemented in 2011 and 2018, along with a comparative analysis of the two.

2.1 Current National Pension System in Taiwan

Taiwan's pension system has a long history, and over the years it has undergone a number of reforms and changes, mostly due to the aging of Taiwan's population as well as the issues it has had with its financial condition. The pension system experienced a serious financial crisis from 1995 to 2005. To ease the nation's financial burden and ensure the pension system's long-term stability, the government implemented a number of reform measures, such as the financial reform of labor insurance and the creation of a national retirement fund. From 2005 to 2013, the government continued to promote pension system reform, including the implementation of the second phase of labor insurance financial reform, pension reform for public and educational personnel, and the formation of a pension reform committee to strengthen supervision and improve Financial Stability and Security Level of Annuity System. The government then launched the universal pension system in 2014, which provided monthly pensions to eligible workers, self-employed

individuals, and farmers after retirement, further enhancing the integrity of universal pension protection. Last but not least, from 2018 until the present, the government has continued to support the reform of the system, including revision of the new labor retirement system, revision of the annuity system for civil servants and military, public and educational personnel, and promotion of the pension system for specific industries, etc., in order to further strengthen the financial stability and fairness of the annuity system.

Three levels and three categories can be used to categorize Taiwan's annuity system in order to ensure everyone's quality of life and financial security as they age, increase annuity protection and financial stability. The first level of the system is the national annuity system; the second level includes the labor retirement system, the retirement pension system for government employees, military personnel, and public and educational employees; and the third level is the enterprise annuity system. For those who have not taken part in any public or private pension insurance system or other pension systems, the National Pension is a national basic pension. Its primary funding source is the national treasury budget, and the Central Health Insurance Administration is in charge of overseeing it. The second-tier pension system consists of the military, public, and educational retirement pension systems as well as the labor pension system for public servants. The Labor Insurance Bureau and various competent authorities are in charge of managing these two types of annuity systems, which are based on particular occupational categories. Their main sources of funding are pension funds and labor insurance premiums. Pension plans managed by the business itself make up the third tier of enterprise annuities. It can be categorized into different types like associations, industry groups, independent businesses, and labor mutual funds. The business itself is primarily responsible for providing the funding. In conclusion, Taiwan's pension system is split into three levels and three categories,

offering our people various degrees and types of retirement security.

2.1.1 Public Pension Reform in 2018 in Taiwan

In 2018, Taiwan underwent significant reform to the national pension system, particularly focusing on public-school teachers, civil servants, and military personnel who are deemed as labors who work in public sectors. For public-school teachers and civil servants, the retirement age saw a gradual increase to 65 years[13], and changes were made to the calculation standards for benefits, gradually decreasing the income replacement ratio [14] over a 10-year period. Additionally, adjustments were implemented to the preferential interest rates on savings deposits. To ensure the sustainability of the pension system, payroll contributions into the pension fund were raised, and all savings resulting from reduced benefit payments and preferential interest rates were reinvested back into the pension system trust fund. From an intuitive perspective, reducing the preferential savings deposit interest rate for public servants would mean a decrease in their lifetime income after retirement.

Regarding military personnel, the eligibility for pension benefits remained unchanged at 20 years of service. However, there were revisions to the calculation standards for monthly retirement income, with a floor set for minimum monthly payments. Preferential interest rates on savings deposits were reduced, and monthly retirement income exceeding the newly calculated standards was phased out gradually over 10 years. To address military pension fund deficits arising from armed forces downsizing, the government committed to transfer NT$100 billion the next decade to

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[13] Before 2021, the retirement conditions for public servants to claim their pension benefits required a minimum of 15 years of service and a minimum age of 60. Starting from 2022, the required years of service remained at 15 years, but the pension entitlement age was increased to 61, and subsequently, it will increase by one year annually. By 2026, the entitlement age for pension benefits will be uniformly set at 65 years

[14] The replacement rate refers to the ratio of a retiree's annual retirement income to their final salary income before retirement. In other words, it is the proportion obtained by dividing the retiree's annual retirement income (numerator) by their final salary income before retirement (denominator). This ratio is known as the retirement income replacement rate.

support the pension system. As with the other sectors, any savings resulting from the adjustments in benefit payments and interest rates were directed towards the military pension system trust fund.

While different perspective might lead to different results. From the standpoint of applying the nominal wage hypothesis model in the labor market, a study by Lai, W.W et al. (2017) argues that the reform of the pension system might result in a reduction of employment rates due to both decreased nominal wages and rising inflation, which in turn would lead to a decrease in real wages. As a result, this could discourage workers from entering the labor market, leading to reduced labor supply and a potential increase in unemployment rates.

However, the pension reform implemented in 2018 is likely to have increased the labor supply in the public sector. By deferring the retirement age and reducing the income replacement ratio over time, the reform provided incentives for individuals to work longer and stay in the labor force for a more extended period. This resulted in higher labor force participation rates among public-sector employees, as they sought to secure a more substantial pension upon retirement.

2.1.2 Public Pension Reform in 2011 in Taiwan

In 2011, the "Civil Servants Retirement Act" underwent significant reforms, primarily focused on extending the age at which voluntary retirees can start receiving retirement benefits and adjusting the replacement rate of income. Previously, the policy allowed civil servants who had served for 25 years or more to start receiving monthly retirement benefits at the age of 50, leading to an increasing proportion of early retirement among civil servants and a declining average retirement age. With the aging population, many countries have proposed reforms to extend the retirement age in their pension systems.

In the same year, Taiwan extended the age at which civil servants can start receiving retirement benefits to 60 years old, provided they have served for at least 25 years and choose to retire voluntarily. For those with longer tenure of at least 30 years, they can start receiving monthly retirement benefits at the age of 55. Additionally, the 2011 pension reform changed the retirement criteria for civil servants from the "75 system" to the "85 system." Previously, the sum of the years of service and the retirement age needed to reach 75, but it was increased to 85. Furthermore, the upper limit of the allocation rate for the retirement fund was raised from 12% to 15%.

The modification of the replacement rate has been frequent between 2006 and 2011. In 2006, the reform of the civil servants' retirement pension system set the upper limit of the replacement rate at 85%. In 2006, the calculation method of the replacement rate included the denominator, which comprised supervisory differential pay and base salary. This expanded the retirement pension base for both supervisors and civil servants. Under a certain replacement rate, supervisors received higher retirement pensions compared to regular civil servants, leading to the issue of disproportionate benefits between higher-ranking officials and lower-ranking staff, commonly known as the problem of "fat cats and lean rats."

To address this, the government revised the replacement rate of the civil servants' retirement pension system in 2010, raising the upper limit from 75% to 95%. Simultaneously, the calculation method for the replacement rate was adjusted. The numerator now includes monthly retirement pensions and preferential deposit interest, while the denominator is adjusted to be twice the base salary.

Table 1 illustrates the comparison of public servants' retirement pension system reform in 2011 and 2018.

Table 1

Comparison of Public Servants' Retirement Pension System Reform

	Reform in 2011	Reform in 2018
Preferential Saving Rate	18% preferential saving rate	The preferential saving rate of 18% will be reduced to zero after 2.5 years. It was decreased to 9% in 2020 and cut down to zero in 2021
Income Replacement Rate	The replacement rate ranges from 75% to 95%. For individuals with less than 25 years of service, the rate is set at 75%. It increases by 2% for each additional year of service, up to a maximum of 35 years	Over a span of 10 years, the replacement rate gradually decreases from 75% to 60% (taking an example of individuals with 35 years of service)
Retirement Age (25 Years of Service)	The retirement age is extended from 50 years old to 60 years old	The retirement age is gradually extended from 50 years old to 65 years old
Retirement Conditions	'75 system' to '85 system'	Implementing the transition from the '85 system' to the '90 system'
Allocation Rate	Increased from 12% to 15%.	Adjusted the allocation rate range to 12% to 18%, while the government and individuals still share the ratio of 65% to 35%.

2.2 Current Employment Situation in Taiwan

As of April 2023, the employment situation in Taiwan is generally stable, with a low unemployment rate and a steady increase in the number of employed people. According to the latest data released by the Directorate-General of Budget, Accounting and Statistics (DGBAS), the unemployment rate in March 2023 was 3.45%, slightly up from the previous month but still within a low range. The number of employed persons was 11.32 million, an increase of 0.17% compared to the same period last year.

In terms of industries, the service sector remains the largest employer, accounting for around 70% of the total employed population, followed by the manufacturing sector and the construction sector. In recent years, there has been a growing demand for skilled workers in fields such as technology, finance, and healthcare.

However, there are also some challenges in the employment market, such as a relatively high percentage of non-regular and part-time workers, which may affect their job stability and income security. In addition, the COVID-19 pandemic has had a significant impact on the job market, especially in the tourism and hospitality industries.

Lai, W.W et.al (2017) posits that the reform of the pension system has a significant impact on nominal wages. The service sector, which primarily caters to the domestic market, is more affected by a decrease in household consumption, coupled with increased labor costs. As a result, the magnitude of nominal wage reduction in the service sector is generally higher than that in the industrial sector, particularly in wholesale and retail, transportation and storage, and accommodation and food services industries.

In terms of employment, the service sector shows a more pronounced response to pension system reform. Besides experiencing greater job losses in the service sector,

certain domestically oriented industries in the manufacturing sector, such as processed food, garments and apparel, and pharmaceuticals, also face higher negative impacts on employment (Lai, 2017).

2.3 Policy Analysis in the Labor Market

Numerous studies have explored the impact of adjustments in retirement age on labor market outcomes, employing various methods to investigate the effects of pension reforms on the labor market. One notable study conducted by Rodina, A. (2021) analyzed the 2018 pension reform implementation by increasing the official retirement age from 60 to 65 for men and from 55 to 60 for women in Russia. The author utilized a DID and synthetic control approach demonstrating that individuals close to the retirement threshold, and thus most affected by the pension reform, experienced reduced confidence in the current and future economic situation in the country, as well as in their personal future prospects and financial situation.

Another research, Manoli and Weber (2016) utilize policy gaps in the Austrian pension system to examine individuals' willingness to delay retirement in response to expected increases in retirement benefits. Behavioral response relies on robust data from administrative registers, which reveal distinct spikes in retirement entries at specific tenure levels for severance pay eligibility. Specifically, in the Austrian context, one key friction arises from deviations in worker-employer negotiations regarding personalized severance packages, bypassing the legislated policy gaps.

Similar study posits by Montizaan and Vendrik (2014) sheds light on the intricate mechanism through which pension system modifications influence individuals' well-being and job satisfaction. Social comparisons play a crucial role in this context, as people tend to assess their own circumstances relative to others within different age groups experiencing distinct exposure to the reform.

Consequently, those subjected to more favorable or unfavorable changes in their pension benefits compared to their peers may experience shifts in their job satisfaction levels.

2.4 National Pension Across Countries

Different countries have either a single-tier or multi-tiered (include double tier and tri-tier) designs for their public pension systems. Take Japan and Korea for instance, they apply double-tier whereas the US applies a single-tier public pension system.

The National Pension and Welfare Pension are the two main divisions of the Japanese pension system. All Japanese citizens aged 20 to 60 years old are eligible for the national pension. The basic pension system is a requirement for all citizens. All citizens are required to enroll as insurers, and insured people can apply to join the pension system. When Japanese citizens reach the age of 20, they will be the first, second, and third insurant based on their identities, according to the administrative procedure for applying to become an insurer. Therefore, the national pension can reduce occupational disparity, assist in implementing a social security system based on social insurance, and foster social cohesion (Guan 2013). All employees of the Welfare Pension Insurance Company form the basis of the Welfare Pension, and anyone who joins the Welfare Pension automatically becomes the second insurer of the National Pension.

As a result, if you receive an annuity, you can join the public annuity system by paying the first insured person's direct premiums. Employees in the employed classes and other groups who fall under the second insurer category of insured people will have the premium deducted from their salary. The third insurer, who is typically a housewife/husband or spouse supported by an employee or a public servant, has no obligation to pay the premium but instead does so via the company of the second

insured. In order to lessen the burden on the following generation, Japan's public annuity adopts the pay-as-you-go (PAYG) system and primarily uses the premiums paid by the insured as the funds for the annuity payment.

In order to respond to and prevent citizens' aging and death, the Korean government has a social security system that can pay annuities to the individuals. The national pension system in South Korea is primarily comprised of three tiers. The elderly over 60 years old who receive the basic pension and social assistance recipients who live below the poverty line constitute the zeroth tier. The first tier consists of the national pension for employees and the annuity for certain specific occupations (such as public servants, teachers at private institutions, and soldiers), the second tier is made up of enterprise annuities, and the third tier is made up of private annuities. Korean pension payments can be mainly divided into these three categories: old-age pension, early old-age pension, and split pension. It is evident that the retirement age has risen and that the importance of the employment policy for the elderly has grown. According to Lu (2019), the annuity payment formula in South Korea also serves as a means of income redistribution. The consumer price index is taken into account when determining the annuity payment level and it is the nation's responsibility to pay annuities and set up a system for their payment. Shen (2018) also indicated in his report that the South Korean government has a propensity to raise the ratio of national pension benefits year after year.

3. Methodology

3.1 Empirical Method

Governments from different countries may omit some factors when implementing policies or reforms because of some unobservable variables (Mao and Wu, 2016).In recent years, the difference in difference (DID) estimation method has become one of the most widely used estimation methods in economics and policy evaluation. Similar studies in Taiwan have used this method to evaluate issues. One study (Yang, 2005) discovers the impact of New Labor Pension Act on Private Sector Labors using manpower utilization survey data from year 2003-2004 and 2006-2007 by using difference in difference method. Another similar study (Cheng, 2018) looks into the impact of year 1995 and 2011's reform of public servants' retirement on working hours and wage rates.

The difference in difference estimation framework requires three explanatory variables, the experimental group dummy variable, the post-policy implementation dummy variable, and two interaction terms. To explore the effect of this policy, it is necessary to control for other variables, as there are some differences in labor between the private and public sectors. Among them, variables such as education level, marital status, major and primary jobs are control variables, the length of working hours and monthly wages are the outcome variables, and the treatment variable is the effect after the National Pension Reform is implemented. The samples were divided into experimental group and control group. Labors who are employed by the government are viewed as the experimental group and labors who work for private corporations, independently, or other employers consists the control group.

Furthermore, the DID empirical model's premise assumes that when the policy is not implemented, the direction of the explained variables in the samples of the control

group and the experimental group before and after the policy's implementation are parallel trends. In this research, when the national pension reform policy is not implemented, the average wages and average working hours of public sector employees and private sector employees are in parallel directions , which is consistent with the parallel trend assumption of the DID empirical model. Thus, the DID empirical method can be used to examine the impact of changes in the pension reform policy on wages and working hours of public and private sector employees.

The DID equation for working hours and monthly wage will be expressed in the formula (1) and (2):

$$InHr_{it} = \beta_0 + \beta_1 treated_i + \beta_2 yr_{2015-2020} + \beta_3 policy_{it} + \beta_4 Z_i + e_{it} \quad (1)$$
$$policy_{it} = treated_i \times yr_{2015-2020}$$
$$InWage_{it} = \beta_0 + \beta_1 treated_i + \beta_2 yr_{2015-2020} + \beta_3 policy_{it} + \beta_4 Z_i + e_{it} \quad (2)$$
$$policy_{it} = treated_i \times yr_{2015-2020}$$

Hr_{it} denotes the weekly working hours of each sample i in t terms, while $Wage_{it}$ denotes the monthly wage of each sample i in t terms. $Treated_i$ indicates the dummy variable of labors that are employed by the government. Labors who work in the government sector are set as 1 while labors who work in the private sector are set as 0 which includes private employees, self-employed people and others. $yr_{2015-2020}$ is the time dummy. If the National Pension Reform occurs after 2018, it will be set to 1, and if it occurs before 2018, it will be set to 0. $Policy_{it}$ denotes the interaction term for $treated_i$ and $yr_{2015-2020}$. The respondents' who worked in a public sector that are affected by the National Pension Reform will be set to 1, otherwise 0. Besides, the coefficient of $effect_{it}$ β_3 implies the policy effect. This is also one part that we are interested to discover in this research, since it represents the impact of National Pension Reform on public sector employer's working hours. This is the estimation

method by using the DID method. Z_i represents other variables that might affect the working hours in the labor market such as, education level, gender, living region, marital status, major, etc. e_{it} is the error term.

3.2 The Data

This study focuses on the National Pension Reform which is put in place on July 1st, 2018. Thus, it adopts the data of Manpower Utilization Survey Data from year 2016 to 2017 and 2019 to 2020. The current survey sample consists of about 20,000 households. The survey objects of the manpower utilization survey are primarily ordinary households and joint business households living in Taiwan, whose households are at least 15 years old and are primarily citizens (excluding armed labor, supervision and depressed labors) of their nationality who are free to engage in economic activities (nearly 60,000 people). Besides, the manpower utilization survey includes not only basic information about individuals (such as gender, age, education level, and marital status), but also data on working hours, salaries, and public and labor insurance.

There will be a problem with repeated sample selection because the human resources survey will follow up on some of the samples from the prior year every other year. As a result, we will start by repeating samples in a series. In order to solve the issue of repeated sample selection, variables like gender, age, and residential area are used to identify and eliminate repeated selection samples.

3.3 Model Specification

Variable Selection

The explanatory variables in the DID empirical model of working hours are divided into weekly working hours $Inhr_i$ to examine the effects of the reform of the retirement system for public servants on the working hours of those in the public sector. The DID empirical model's explanatory variables include the time dummy variable of whether the person is a public servant after the national pension reform, the dummy variable of whether the person works for the public sector, and the interaction term between these two variables. $Treated_i$ is a dummy variable that indicates whether the employee works for the government in the public sector; if so, it is set to 1; otherwise, it is set to 0. The time dummy variable $yr_{2015-2020}$ denotes the period of time following the public servants' retirement. The time dummy equals to 1 if it is after the policy reform, which is after year 2018 and equals to 0 if it is before year 2018. The interaction term of the dummy variable of public sectors employees and the time dummy variable after national pension reform is considered $policy_{it} = treated_i \times yr_{2015-2020}$. If an employee is a public servant who is employed by the government after the national pension reform, it will be denoted as 1, otherwise 0.

Dependent Variables

The dependent variable in this study that we want to discover is the weekly working hours and monthly wage of individual employed workers in the public and private sectors. Since each employed worker had a different length of working hours and earns differently in monthly wages, this study would like to know if the 2018 national pension reform has an effect on working hours and monthly wages in both public and private sectors.

Independent Variables

Personal background will also influence the working hours and monthly wages of each employed workers. Gender, age, marital status, education level, primary job, major and living region are variables that might affect the working hours of employed workers.

(a) Gender

Under the consideration that male and female has different characteristics that they play a different role in the society and in the labor market. Male are often considered to focus more on their career thus they might have a longer working hours as well as have a higher income. Therefore, a dummy variable is set with male equals to 1 and female equals to 0.

(b) Age

Age is divided into seven brackets, which will be below 20, 20~29, 30~39, 40~49, 50~59, 60~65 years old and people that are above 65 years old with dummy variable, considering the legal working age in Taiwan is eighteen, thus we drop respondents' who are below age eighteen.

(c) Marital Status

The traditional concepts of males are the primary breadwinners and women are the homemakers have been existed in the society for decades. Although advocators promotes gender equality in recent years, housework burden still fall onto women. Therefore, the marital status of each employed workers is also another variable that should be considered which might affect the working hours and monthly wages. For respondents' that were married are set as 1 and otherwise which includes unmarried, divorce, separate, companion loss are set as 0

(d) Educational Level

Education is deemed as an accumulation of human capital which plays a critical role in the labor force participation among countries under labor economics theory.

Chen, J et.al(2014) mentioned in their study that while higher education is commonly considered to be related to higher wages and more opportunities. Education also has an impact on fertility and later childcare, which in turn has an impact on working hours and monthly wages. Employed worker with a higher education are expected to have longer working hours and earn more per month. Therefore, in this study , years of schooling are taken into consideration, where primary school level is set as 6, junior level is set as 9, senior high and vocational high school are set as 12, junior college is set as 14, university level is set as 16, master level is set as 18, post-doctoral degree is set as 23. For respondents' who self-learned on their own is deemed as 9 years of schooling and illiterate respondents' are set as 0 years of schooling.

(e) Major

A person's major in college plays a significant role in shaping your future and influencing various aspects of your life. The choice of your major determines the specific knowledge and skills you acquire during your academic journey, which can greatly impact your career prospects, personal development, and overall success. A well-chosen major aligns with your interests, strengths, and career goals, providing you with a solid foundation in a particular field of study. For example, if you major in computer science, you can develop expertise in programming and technology, opening doors to lucrative job opportunities in the ever-expanding tech industry. Similarly, majors such as business, engineering, healthcare, or the arts equip you with specialized knowledge that can lead to diverse and rewarding career paths. Furthermore, your major also influences your network and connections within your chosen industry, as you interact with professors, classmates, and professionals in your field. This network can provide valuable mentorship, internship opportunities, and potential job prospects. In

summary, your college major serves as a compass guiding you towards your desired future, shaping your skill set, expanding your knowledge, and positioning you for success in your chosen field. Thus, this study divides this variable into fourteen brackets based on different majors according to the data that was provided by the Manpower Utilization Survey and create a dummy variable for it. These fourteen majors are listed and shown in table 2.

(f) Primary Job

A person's primary job choice can affect the labor market in several ways. The choice individuals make about their careers collectively contribute to the demand and supply dynamics of the labor market. Jobs that require specialized skills and expertise tend to command higher wages, while oversupply of workers in a particular field can lead to wage decreases. A significant number of individuals pursuing careers in a particular field can influence the growth or decline of that sector, and can also contribute to the development of a highly skilled labor force.

However, the impact of individual job choices can be influenced by broader economic factors, technological advancements, government policies, and societal trends, making the labor market a complex system. There are different types of jobs in Taiwan. According to the Standard Occupational Classification System, the jobs had been categorized into 9 big categories. The name of each category or listed in the table below. To have a deeper insight on the labors' primary job identity, a dummy variable is created for each category. Table 2 is the dependent and independent variable for the empirical regression model of working hours and monthly wage.

Table 2

Empirical Regression Model for Working Hours and Monthly Wage

Dependent Variables	Definition of the Variables	Remarks
$Hour_i$	Weekly Working Hours	Discrete
$Wage_i$	Monthly Wage	Discrete
Independent Variables	**Definition of the Variables**	**Remarks**
$Policy_{it}$	$Policy_{it} = Treated_i \times Year$	Dummy
Year	$\begin{cases} After\ the\ Public\ Servants'Pension\ Reform = 1 \\ Otherwise = 0 \end{cases}$	Dummy
$Treated_i$	$\begin{cases} \text{Public Sector Employee} = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Gender	$\begin{cases} Male = 1 \\ Female = 0 \end{cases}$	Dummy
Age 1	$\begin{cases} Below\ 20\ Yrs\ Old = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Age 2	$\begin{cases} 20 - 29\ Yrs\ Old = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Age 3	$\begin{cases} 30 - 39\ Yrs\ Old = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Age 4	$\begin{cases} 40 - 49\ Yrs\ Old = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Age 5	$\begin{cases} 50 - 59\ Yrs\ Old = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Age 6	$\begin{cases} 60 - 65\ Yrs\ Old = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Age 7	$\begin{cases} Above\ 65\ Yrs\ Old = 1 \\ Otherwise \end{cases}$	Dummy
Major 1	$\begin{cases} Liberal\ Art = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Major 2	$\begin{cases} Law = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Major 3	$\begin{cases} Business, Management, Communication = 1 \\ Otherwise = 0 \end{cases}$	Dummy

Major 4	$\begin{cases} Science = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Major 5	$\begin{cases} Engineering = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Major 6	$\begin{cases} Agriculture = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Major 7	$\begin{cases} Medicine = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Major 8	$\begin{cases} Military\ Police = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Major 9	$\begin{cases} Education = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Major 10	$\begin{cases} Human\ Ecology = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Major 11	$\begin{cases} Art, Design = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Major 12	$\begin{cases} Sociology = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Major 13	$\begin{cases} General\ Education = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Major 14	$\begin{cases} Others = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Primary Job 1	$\begin{cases} Legislators, Senior\ Officials\ and\ Managers = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Primary Job 2	$\begin{cases} Professionals = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Primary Job 3	$\begin{cases} Technicians\ and\ Associate\ Professionals = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Primary Job 4	$\begin{cases} Clerical\ Support\ Workers = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Primary Job 5	$\begin{cases} Service\ and\ Sales\ Personnel = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Primary Job 6	$\begin{cases} Agriculture, Forestry, Fishing\ and\ Animal\ Husbandry = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Primary Job 7	$\begin{cases} Crafted\ and\ Related\ Trade\ Workers = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Primary Job 8	$\begin{cases} Plane\ and\ Machine\ Operaters, Assemblers = 1 \\ Otherwise = 0 \end{cases}$	Dummy

Primary Job 9	$\begin{cases} Elementary\ Labourers = 1 \\ \qquad\qquad Otherwise = 0 \end{cases}$	Dummy
Marital Status	$\begin{cases} Married = 1 \\ Otherwise = 0 \end{cases}$	Dummy
Education Level	Years of Education	Discrete
$North_i$	$\begin{cases} North\ Region = 1 \\ \quad Otherwise = 0 \end{cases}$	Dummy
$Central_i$	$\begin{cases} Central\ Region = 1 \\ \quad Otherwise = 0 \end{cases}$	Dummy
$South_i$	$\begin{cases} South\ Region = 1 \\ \quad Otherwsie = 0 \end{cases}$	Dummy
$Yeardummy_i$	Yearly Fixed Effect	Yearly Dummy

4.   Results

4.1 Data Source of Monthly Wage and Working Hour

The DID empirical model of wage and working-hour changes utilizes the Accounting Office of the Executive Yuan's human resources utilization survey as its data source from 2015 to 2020.[15]This study primarily examines the impact of the pension reform put into effect in 2018 on labor conditions in Taiwan and pools cross-sectional data from years before and after the reform's implementation. The impact of this policy on labor conditions in the public and private sectors will also be further examined in light of other factors that may influence, such as age, marital status, education level, major, and occupation. Employees in the private sector are considered the control group, while those in the public sector are considered as the experimental group. Employees in the public sector include those who work for the government, such as public

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[15] The Academia Sinica Research Center for Humanities and Social Sciences' academic survey research database was utilized as the source for the human resources utilization survey. It is based on data from a sample survey of the non-government population that is 15 or older and is conducted in May annually; it excludes members of the armed forces and people under supervision. This data is a cross-sectional data.

servants, contractors, temporary workers, etc., as well as non-government workers like business owners, self-employed workers and private employers. In order to reduce differences between the samples of workers in the public and private sectors, employees who work less than forty hours per week will be eliminated in order to ensure that the sample chosen includes only full-time workers. Furthermore, according to the Ministry of Labor's July 1st 2015 minimum wage adjustment, the minimum wage in that year was adjusted to 20,008 per month. Because the minimum wage is adjusted annually, this research considered the minimum wage in 2018, which is 23,100 per month; therefore, monthly wages less than 23,100 will be deleted.

4.2 Working Hours in Public and Private Sector

Civil servants are required to report for work during the assigned hours without arriving late or departing early, per the updated " Regulations of Implementation Program for the Civil Servants' Two－Day Weekend " published on August 31, 2018. Eight hours a day, forty hours a week, and two days off should be their standard workweek. They might be asked to work longer shifts if necessary, but no more than 12 hours per day or 60 hours per month. A minimum of 11 consecutive hours must pass between shifts for employees of the government who work in shifts.

As stated in the latest "Regulations for Overtime Pay of Government Agencies" issued on December 21, 2022, overtime pay is calculated on an hourly basis. On regular workdays, overtime should not exceed four hours, while on days off and statutory holidays; it should not exceed eight hours. The total monthly overtime hours should not exceed 20 hours. The calculation for overtime pay is based on the sum of a civil servant's monthly salary and professional allowance, divided by 240. For supervisors and non-supervisors, the calculation is based on their respective managerial position allowances or the sum of managerial position allowances and

job-specific allowances. The result is also divided by 240. As for contract employees, their monthly salary is divided by 240 to determine the overtime pay rate.

According to Cheng (2018), due to the government's limited budget, agencies tend to offer compensatory leave as a form of overtime compensation to reduce personnel expenses. After undergoing several pension reforms, the retirement regulations for civil servants have become increasingly stringent, potentially increasing people's desire to retire early. To address the labor shortage in the short term, the government may opt for hiring contract or temporary employees. In the long term, considering budget constraints, the government may reduce the number of employees in the public sector for established work operations or hire more contract employees to decrease future pension payments. Therefore, the reform of the civil servants' retirement system has led to a more stringent system and an increase in working hours.

According to the data from the manpower utilization survey data, labor market workers are classified into nine major categories based on the Taiwanese Occupational Classification System. This study focuses on employees in these nine categories and examines the changes in working hours for private sector workers after the reforms in 2011 and 2018. Based on statistics from the Ministry of Labor's database, the average monthly regular working hours for women in 2011 were 169.2 hours, while for men it was 171.2 hours. The average total regular working hours in 2011 were 170.3. In 2018, the regular working hours for women were 160.3 hours, for men it was 162.2 hours, and the average total regular working hours were 161.3. In recent years, due to increased labor awareness and emphasis on work-life balance, employees have become more concerned about their rights. Starting from 2015, there has been a noticeable decrease in working hours. The rights of private sector workers are protected by the "Labor Standards Act," which has undergone frequent revisions in recent years. According to the revision implemented on May 8, 2015, the regular

daily working hours should not exceed 8 hours, and the weekly working hours should not exceed 40 hours. A minimum of 30 minutes of rest should be provided after working for 4 hours continuously. There should be 2 days of rest within a 7-day period, including 1 statutory holiday and 1 rest day. The combined total of regular and extended working hours should not exceed 12 hours per day, and the total number of extended working hours in a month should not exceed 46 hours.

The figure below adapts the manpower utilization survey database depicting the working hours of employed workers in Taiwan from 2016 to 2020 which includes the pension reform period. The figure shows that the weekly working hours of employed workers in the public sector are lower than those in the private sector.

2018 is the year of National Pension Reform that this study aims to target, working hours increased slightly the following year. There is a significant reduction in working hours for both the private and public sectors due to the pandemic period. Thus, this study would like to ignore and will not be discussing about the change that occurs in the pandemic period. Figure 3 illustrates the working hours by gender, demonstrating that male working hours are significantly greater than female working hours and the total employed workers in Taiwan.
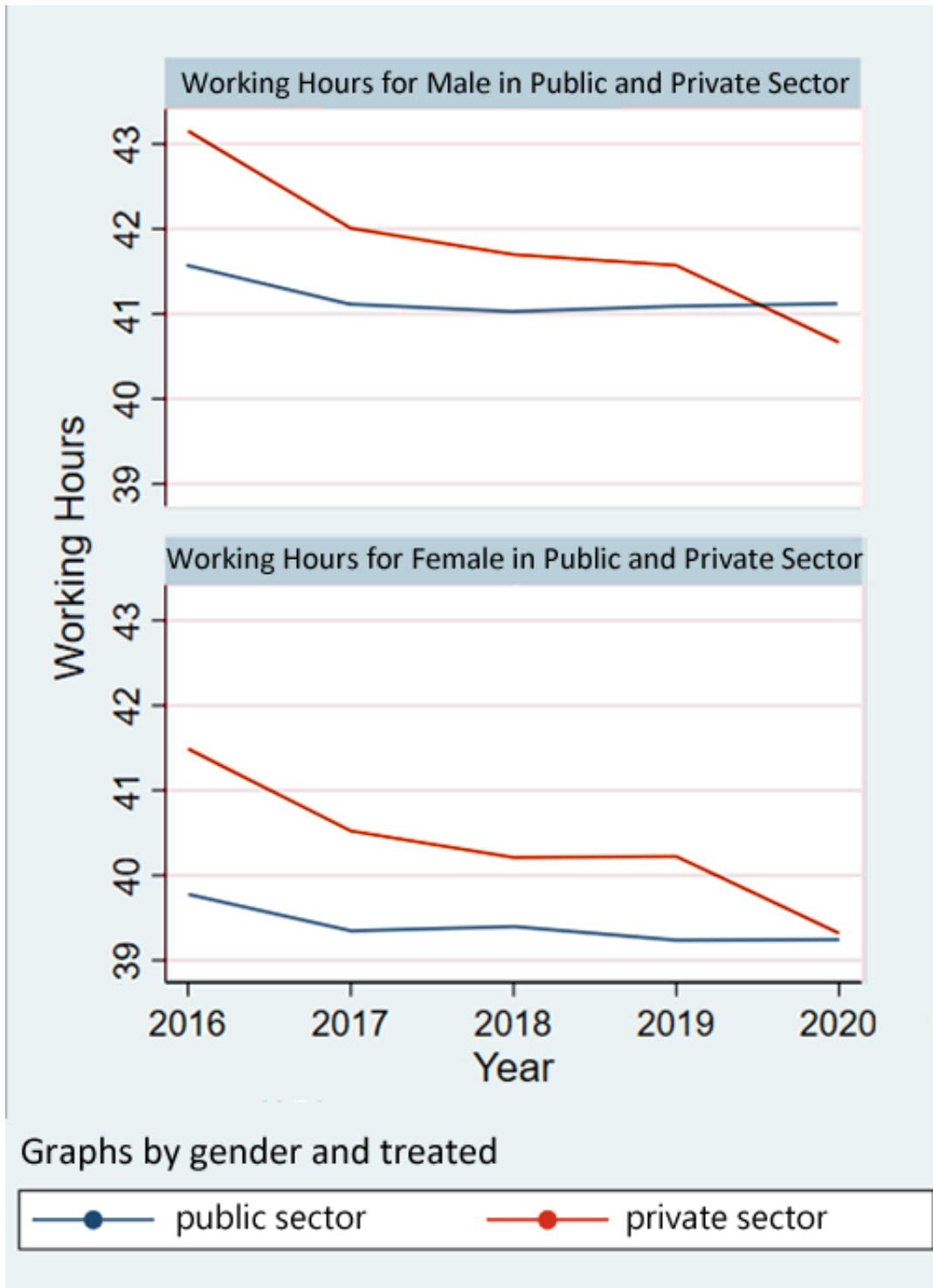
Figure 3 Working Hours for Female and Male in Public and Private Sector in 2018's

Pension Reform

4.3 Monthly Wages in Public and Private Sector

Figure 4 depicts the monthly wage for male and female in the public and private sector. The salary payment of Taiwan government employees is primarily based on the "Public Servants' Salary Act" (Article 26 of the Public Servants' Salary Act) and the "Regulations on the Payment of Salaries to Public Servants" (Article 3 of the Regulations on the Payment of Salaries to Public Servants). The calculation of public servants' salaries is mainly based on the sum of basic salary and seniority salary[16].

The basic salary is the fundamental compensation for public servants and varies according to their position levels, ranging from the first grade to the fourteenth grade. Allowances can be categorized as position allowance, technical allowance, and regional allowance. The Executive Yuan periodically adjusts the salaries of government employees based on indicators such as the consumer price index, private sector salary levels, average national income, and economic growth rate as a benchmark.

Cheng (2018) mentioned that after the 2011 pension reform, the impact on the salary adjustment of government employees has an increase in wages. In 2011, the salary adjustment for government employees was 3%. Taking the example of appointed personnel at the fifth grade, the real salary was NT$43,350, while in 2018, the real salary was NT$46,460. However, the global financial crisis in 2008 resulted in a slowdown in global economic growth, increased unemployment rates, and less significant growth in private sector salaries.

As a result, the salary of government employees remained unchanged during the five years around 2011. After the pension reform in 2018, a 3% salary adjustment was

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[16] The "seniority pay" is a salary subsidy determined based on the working years of government employees. The amount of seniority pay for government employees increases as their years of service in the public sector increase. Typically, the amount of seniority pay is calculated based on the employee's working years and the corresponding seniority pay rate.

implemented for military personnel, civil servants, and educators. However, at the end of 2019, the COVID-19 pandemic broke out, leading to severe global unemployment rates and inflationary conditions. Therefore, in 2024, the government also implemented a 4% salary adjustment for military personnel, civil servants, and educators. This marked the third salary adjustment for government employees in recent years and the largest adjustment in recent times.

Since 2000, military personnel, civil servants, and educators have only received four salary adjustments, which occurred in 2001, 2005, 2011, and 2018. However, these adjustments were all at a rate of 3%. Interestingly, these years coincided with the implementation of pension reforms. In particular, after the pension reform in 2018, the retirement pension for government employees decreased, and the 3% salary adjustment by the government created a negative relationship between retirement pension and salary.

Private sector workers are governed by Article 21 of the Labor Standards Act, which states that wages are determined through negotiation between employers and employees, but must not be lower than the minimum wage[17]. According to statistics from the Ministry of Labor, the average real regular monthly salary (referred to as average monthly salary) for industrial and service sector workers in 2011 was 38,607 NTD. In 2018, the average monthly salary increased to 40,164 NTD, representing a growth rate of 4.03%. Due to international circumstances influencing salary adjustments in the 2000s, coupled with the global financial crisis in 2008 and the COVID-19 pandemic at the end of 2019, our country's economic growth slowed, resulting in reduced labor demand and smaller salary adjustments in the private sector.

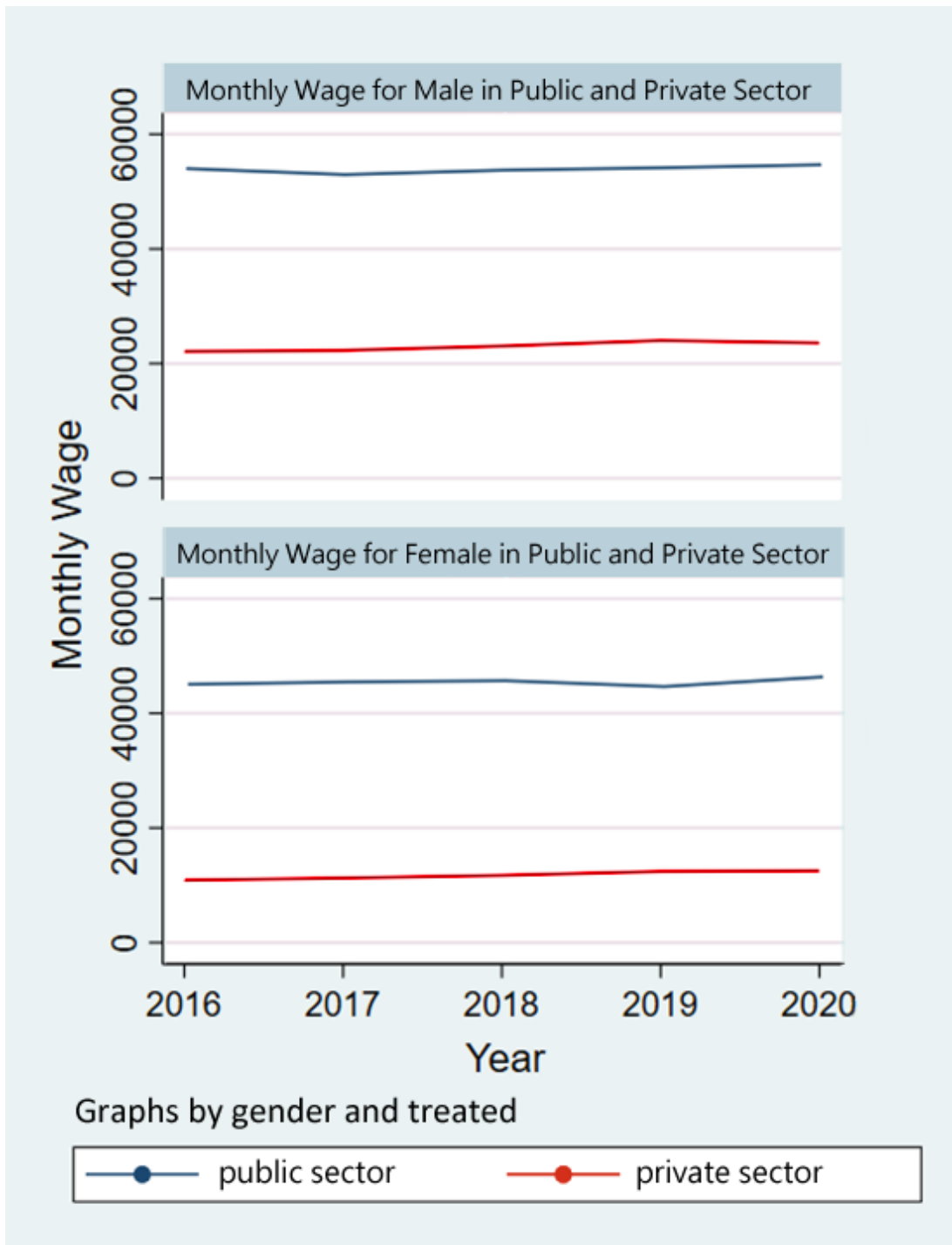[17] In 2023, the monthly minimum wage is set at NT$26,400, and the hourly minimum wage is NT$176.

Figure 4 Monthly Wages for Female and Male in Public and Private Sector

4.4 Descriptive Statistics for Working Hours and Monthly Wages

The average of the variables in the empirical model of wages and working hours is depicted in Table 3 by descriptive statistics. The average of each variable in the public and private sectors is calculated by taking one year before and after the base year for policy implementation, which is 2018. Table 3 shows that following the implementation of the policy, both the public and private sectors' average wages increased, with the private sector's increase in wages coming in at a higher rate than the public sector's, but there was no discernible change in the number of hours worked in the public sector, which increased slightly. In both the public and private sectors, women make up a larger percentage of the dummy variable of gender than men do.

The percentage of women employed in the private sector has slightly decreased since the policy's implementation, while it has slightly increased in the public sector. Even though there are not many people getting married in either of the two sectors, there are still more people whose marital status is married in the public sector than the private sector, according to the dummy variable of marital status. Employees in the public sector have higher levels of education than those in the private sector among the factors of years of education, so those with higher education levels are likely to work in the public sector. After the policy was put in place, employment grew in both sectors.

Table 4 and Table 5 represent the correlation coefficient between wages and working hour variables in 2011 and 2018 pension reform. There is no collinearity issue between the variables because the correlation coefficients of each variable are all less than 0.7 and there is no high correlation.

Table 3

The Mean Value of Wage and Working Hours in 2018's Pension Reform

	Variable	Private sector		Public Sector	
		Pre-Reform (2017)	Post-Reform (2019)	Pre-Reform (2017)	Post-Reform (2019)
Dependent Variable	Wage	36299.6500	38266.2900	50594.9600	50989.1900
	Working Hour	43.4840	43.0744	41.3880	41.4656
Independent Variable	Sex	0.4070	0.4168	0.4981	0.4809
	Age	42.4422	42.8559	44.1341	43.9819
	Marital Status	0.5520	0.5569	0.6276	0.6225
	Education Level	14.4719	14.5282	15.5605	15.7956
	Major	3.3645	4.0671	4.8536	5.1932
	Primary Job	5.1293	5.0716	3.6154	3.6841
Number of Observation		23,118	23,366	2,371	2,485

Table 4

Correlation Coefficient Between Wages and Working Hour Variables in 2018 Pension Reform

		Working Hour	Wage	Sex	Age	Marital Status	Education Level	Major	Primary Job
Dependent Variable	Working Hour	1							
	Wage	0.1397	1						
Independent Variable	Sex	-0.0856	-0.1681	1					
	Age	0.0321	0.2339	-0.1107	1				
	Marital Status	0.0236	0.1357	-0.0329	0.5631	1			
	Education Level	-0.0253	0.1951	0.0484	-0.2428	-0.2172	1		
	Major	-0.0133	-0.0219	-0.0366	0.0118	0.0183	-0.1834	1	
	Primary Job	0.0034	-0.2878	-0.1606	-0.0242	0.0267	-0.4723	0.0788	1

Table 5

Correlation Coefficient Between Wages and Working Hour Variables in 2011 Pension Reform

		Working Hour	Wage	Sex	Age	Marital Status	Education Level	Major	Primary Job
Dependent Variable	Working Hour	1							
	Wage	0.0099	1						
Independent Variable	Sex	0.1011	0.1789	1					
	Age	0.0215	0.2861	0.1434	1				
	Marital Status	0.0097	0.2162	0.1223	0.5135	1			
	Education Level	-0.1726	0.2400	-0.0257	-0.1426	-0.1205	1		
	Major	-0.0577	0.0319	0.0872	-0.0466	-0.0144	-0.0068	1	
	Primary Job	0.0325	-0.0970	0.0539	-0.0282	-0.0136	-0.1704	-0.0226	1

4.4.1 Descriptive Statistics for Primary Job

Table 6 depicts the gender population and ratios of pre and post reform in the public and private sectors. The table demonstrates that as a result of the policy's implementation, there were more men and women employed in the public sector while fewer men and women were employed in the private sector. Taiwanese workers are evidently more likely to work in the public sector than the private sector. This research divides the occupational categories into nine categories in accordance with the classification of the Standard Occupational Classification System of the Republic of China (Rev.6, 2010) and sets a dummy variable to it in order to simplify the occupational categories because the occupational categories covered by the human resource utilization survey are too complicated.

Table 7 illustrates that following the implementation of the policy, the total number of women has increased from 11,929 to 12,204, with the exception of a slight decline in the number of professionals, plane and machine operators, and assemblers. About 2.3% more have been added. In contrast, the number of male employees in the majority of industries has decreased since the policy's implementation, with the exception of technicians, associates, and service and sales personnel. Additionally, the overall population dropped from 16,242 before the policy's implementation to 16,188 after it took effect, a decrease of about 0.33%.

Table 6

Gender Population and Gender Ratios: A Comparison of Pre-Reform and Post-Reform, and Public and Private Sectors

		Private sector		Public Sector	
		Pre-Reform (2017)	Post-Reform (2019)	Pre-Reform (2017)	Post-Reform (2019)
Population	Female	26802	26659	1275	1283
	Male	27008	26452	1243	1360
Percentage	Female	49.81	50.19	50.64	48.54
	Male	50.19	49.81	49.36	51.46

Table 7

Gender Distribution in Different Industries: A Comparison of Pre and Post-Reform

	Female		Male	
Primary job	Pre-Reform (2017)	Post-Reform (2019)	Pre-Reform (2017)	Post-Reform (2019)
Professionals	1,580	1,569	1,776	1,879
Technicians and Associate Professionals	2,001	2,116	2,537	2,720
Clerical Support Workers	2,164	2,240	695	677
Service and Sales Personnel	3,167	3,271	2,684	2,708
Agriculture, Forestry, Fishing and Animal Husbandry	620	637	1,605	1,417
Crafted and Related Trade Workers	427	449	3,465	3,400
Plane and Machine Operaters, Assemblers	1,076	1,027	2,627	2,550
Elementary Laborers	894	895	853	837
Total number	11,929	12,204	16,242	16,188

4.5 Empirical Regression Results of Working Hours

Table 8 shows the empirical results of working hours in the 2011 and 2018 National Pension Reform. To have a clear comparison of the impact, the two reforms were listed in the same table. It's obvious that the reform in 2018 had a significant effect while the one in 2011 doesn't. The reforms in 2011 and 2018 have made the retirement conditions for public servants more stringent and resulted in a reduction in their retirement benefits. However, the extent and content of these two reforms are not exactly the same. The conditions for extending the retirement age and adjusting the replacement ratio in 2018 are stricter than those in 2011, and the amount of retirement benefits will decrease gradually. Therefore, after the policy is implemented, individuals who meet the retirement eligibility criteria have an incentive to choose early retirement or retire within the next one or two years to avoid further reduction in their retirement benefits in the future. As a result, the number of retirees will increase, and to fill the vacancies left by retirees, the government may choose to hire new public servants, contract workers, temporary staff, and so on. Consequently, while unable to fully compensate for the vacancies caused by the retirement wave, the existing workforce will also experience an increase in working hours. Taking a long-term perspective, the government may choose to streamline the budget and reduce fiscal personnel expenses, leading to a potential situation of understaffing and increased working hours.

The other regression coefficients are as follows: the regression coefficient for education years and gender is negative and significant at the 1% level, indicating a negative correlation with working hours. As the level of education increases, working hours tend to decrease. Females, compared to males, have longer working hours. The regression coefficient for age is negative and significant at the 5% level, suggesting that older individuals have shorter working hours. The regression coefficient for

marital status is positive and significant at the 5% level, indicating that married individuals have shorter working hours compared to unmarried individuals.

Table 8

Empirical Results for Working Hours

Dependent Variable: Natural Log of Working Hours in 2011 & 2018		
Year	2011	2018
Treated	-0.0529***	-0.0377***
	(0.00291)	(0.00297)
Post Year	0.00265	-0.0355***
	(0.00310)	(0.00170)
Policy	-0.000611	0.0293***
	(0.00370)	(0.00301)
Sex	0.0148***	-0.0169***
	(0.00356)	(0.00213)
Age	-0.00236*	-0.00411**
	(0.00114)	(0.00113)
Marital Status	0.00337	0.00453**
	(0.00170)	(0.00130)
Education Level	-0.00445***	-0.00328***
	(0.000667)	(0.00374)
Major	0.00311***	0.000587***
	(0.000352)	(0.000204)
Primary Job	-0.000234*	-0.00124
	(0.0000961)	(0.000521)
Constant	3.832***	3.758***
	(0.0112)	(0.00228)
Observations	104468	107768
Adjusted R^2	0.0618	0.0214
Fixed effect on locations		Yes
Fixed effect on time		Yes
Standard errors in parenthesis		
=*p<0.05 **p<0.01 *** p<0.001		

*Note 1*: standard errors are shown in the parentheses

Note 2: *** achieves a 1% significance level, ** achieves a 5% significance level, * achieves a 10% significance level

Note 3: Treated indicates the dummy variable of labors that are employed by the government; Post year represents the years after 2018 and policy denotes the interaction term of denotes the interaction term for treated and post year.

4.5.1 Female and Males' Working Hour in Public and Private Sector

There is a significant increase of rate change increasing from the working hours after the pension reform in 2018. Due to the lower number of females working in both sectors before the policy implementation, the retirement of some individuals following the policy implementation and the government's inability to fill the labor gap in a timely manner has resulted in an extension of working hours in both sectors. Agriculture, Forestry, Fishing, and Animal Husbandry sector has the greatest rate change due to the limited labors working in that public division before the reform.

In accordance to the figure, both male and female workers typically put in longer hours in the public and private sectors. Figure 5 was used to better understand the rise in female working hours following the implementation of the policy and it displays the working hours for men and women in various occupations.
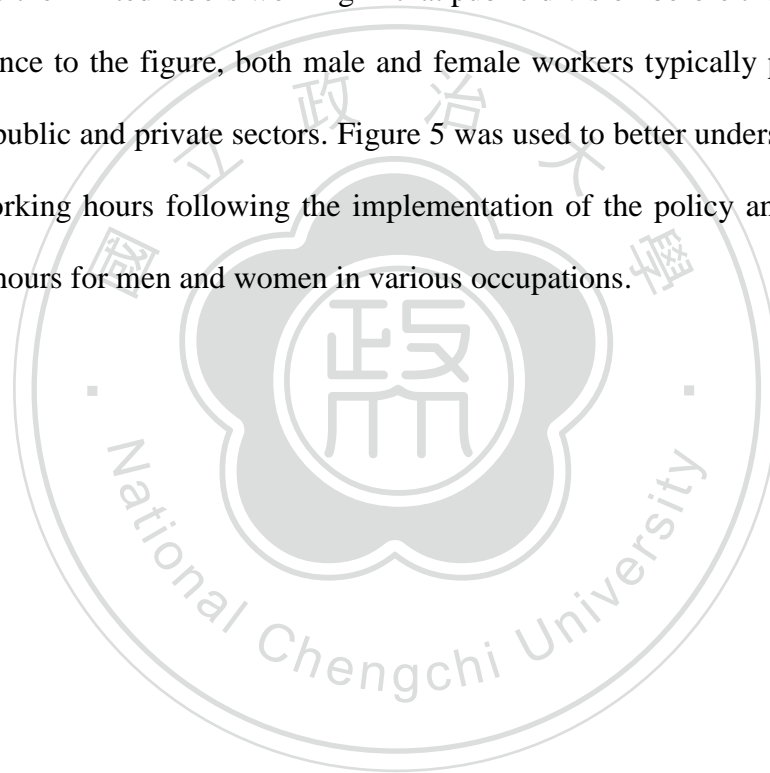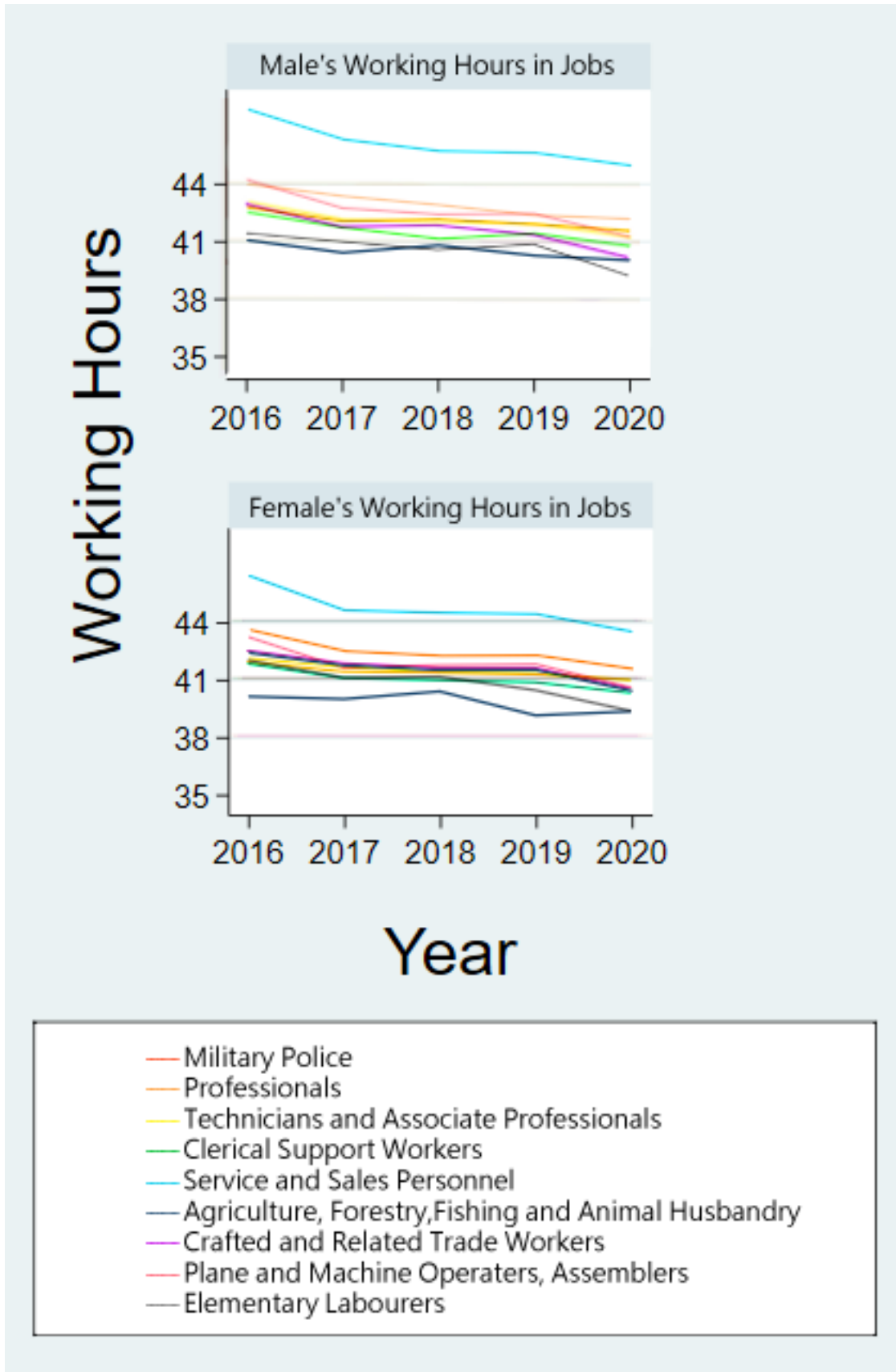
Figure 5 Working Hours for Female and Male in Different Jobs

4.6 Empirical Regression Results of Monthly Wages

Table 9 presents the empirical findings regarding the monthly wages in the 2011 and 2018 National Pension Reforms. The purpose of including both reforms in the same table is to facilitate a direct comparison of their impacts. It is evident that the reform implemented in 2018 had a significant decreasing effect, whereas the one in 2011 did not produce a significant impact.

In the 2011 National Pension Reform, adjustments were made to the replacement rate, retirement age was raised to 60 years old, and the maximum allocation rate increased to 15%. However, in the 2018 reform, these measures became more stringent. The replacement rate, originally ranging from 75% to 90%, was gradually reduced over a decade, reaching 60% annually. The retirement age was progressively extended to 65 years old, and the retirement conditions transitioned from the 85 system to the 90 system. The contribution rate range was adjusted to 12% to 18%. All these changes resulted in stricter eligibility criteria and reduced retirement benefits, which leads to a decrease on monthly wages.

The other regression coefficients are as follows: the regression coefficient for education years, age, and marital status is positive and significant at the 1% level, indicating a positive correlation with monthly. As the level of education and age increases, monthly wages tend to increase. People tend to earn a higher wages with a married marital status. The regression coefficient for sex is negative and significant at the 1% level, suggesting that females, compared to males, have lower monthly wage. The regression coefficient for major and primary job is negative and significant at the 1% level, indicating that people would have a lower income in specific majors and jobs.

Table 9

Empirical Results for Monthly Wages

Dependent Variable: Natural Log of Monthly Wage in 2011 & 2018		
Year	2011	2018
Treated	0.173***	0.0152***
	(0.0233)	(-0.00144)
Post Year	0.00116	0.00626***
	(0.0137)	(-0.000531)
Policy	0.00951	-0.00280***
	(0.0141)	(-0.000927)
Sex	0.186***	-0.0214***
	(0.00933)	(-0.000614)
Age	0.111***	0.00624***
	(0.00842)	(-0.000681)
Marital Status	0.129***	0.0114***
	(0.00736)	(-0.000634)
Education Level	0.0754***	0.00328***
	(0.00452)	(-0.000188)
Major	0.00455***	-0.000271***
	(0.00116)	(-0.0000727)
Primary Job	-0.00215***	-0.00569***
	(0.000480)	(-0.000316)
Constant	8.803***	2.331***
	(0.0700)	(-0.00306)
Observations	99,719	117,768
Adjusted R^2	0.2448	0.2016
Fixed Effect on Locations		Yes
Fixed Effect on Time		Yes
Standard errors in parenthesis		
=*p<0.05 **p<0.01 *** p<0.001		

Note 1: Standard errors are shown in the parentheses

Note 2: *** achieves a 1% significance level, ** achieves a 5% significance level, * achieves a 10% significance level

Note 3: Treated indicates the dummy variable of labors that are employed by the government; Post year represents the years after 2018 and policy denotes the interaction term of denotes the interaction term for treated and post year.

4.6.1 Female and Males' Monthly Wage in Private and Public Sector

In figure 6, it could be seen that female who engage in jobs like military police, professionals, technicians and associate professions, clerical support workers and agriculture, forestry, fishing, and animal husbandry has an increase of their monthly wage after the pension reform in 2018. This could result in the awareness of female rights and the increasing educational level female had gain, which made more women engaged into those jobs.
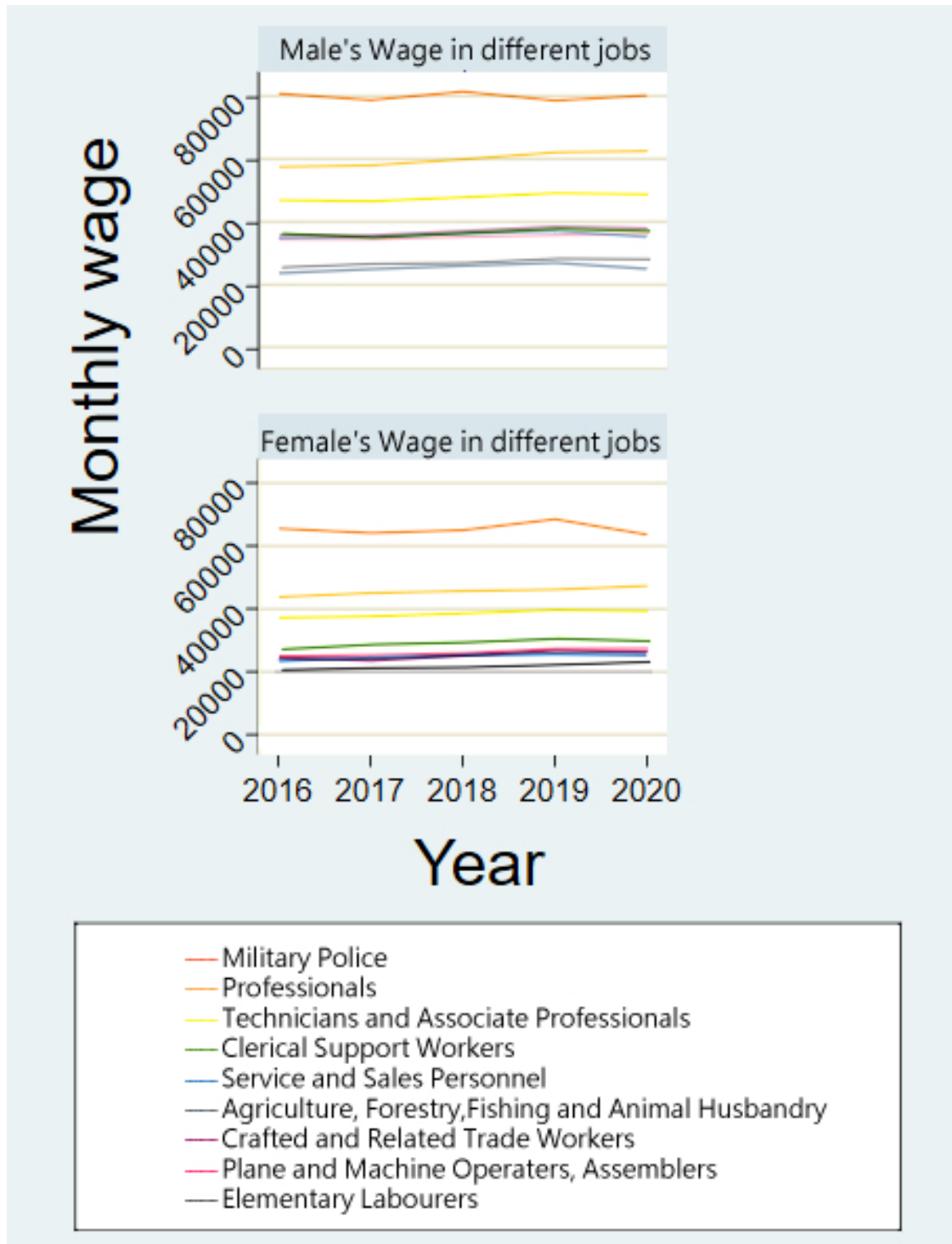
Figure 6 Monthly Wages for Female and Male in Jobs

4.7 Comparisons of the Results and Findings

Similar research has been conducted in previous years, such as Cheng's (2018) study. Cheng (2018) also examined the effects of the 1995 and 2011 pension reforms by selecting three dependent variables: working hours, monthly wages, and labor force participation rate. Additionally, Cheng considered the influence of party alternation and attempted to identify an instrumental variable for it. The study examined the impact of the policy implementation over a range of one to three years. Cheng (2018) suggests that in terms of wages, there were frequent salary adjustments in the public sector during the 1990s. Both before and after 1995, there were increases in public sector employees' salaries, with a larger adjustment in 1995. Therefore, it did not show a significant impact on public sector employees in different periods. However, in 2011, after the reform, the retirement system significantly increased the wage rate for public sector employees in the first year after the reform, but there was no significant effect in the second and third years. Regarding working hours, in 1995, there was a significant increase in working hours due to the removal of preferential savings. In 2011, the reform had a smaller impact compared to 1995, resulting in no significant effect on working hours in the first and second years after the reform, but a significant increase was observed in working hours three years later. The comparison of the results and findings with Cheng (2018) are listed in table 10.

Table 10

Comparison With Cheng(2018)

Year	1995	2011	2011 (My Result)	2018 (My Result)
Working Hour	1 yr: Increase ↑by 1.08%	1 yr: Increase ↑by 0.35 %	Increase ↑ by 0.417%	Increase ↑ by 3%
	2 yr: Increase ↑by 1.37 %	2 yr: Increase ↑by 0.11 %		
	3yr: Increase ↑by 1.45%	3 yr: Increase ↑by 0.46%		
Monthly Wage	1 yr: Decrease ↓ by 0.847%	1 yr: Increase ↑by 3.22 %	Increase ↑ by 0.951%	Decrease ↓ by 0.462%
	2 yr: Decrease ↓ by 0.884%	2 yr: Increase ↑by 0.81 %		
	3yr: Decrease ↓ by 0.44%	3 yr: Increase ↑by 0.33%		

Source: This Study & Cheng 2018

5. Conclusion

5.1 Conclusion and Further Suggestions

Based on the information provided, several key findings and results can be derived. Firstly, the empirical analysis of working hours in the 2011 and 2018 National Pension Reforms reveals that the 2018 reform had a significant impact on working hours, while the 2011 reform did not. The stricter retirement conditions and reduced retirement benefits implemented in the 2018 reform incentivized individuals to choose early retirement, resulting in an increase in the number of retirees. To fill the vacancies left by retirees, the government may have hired new civil servants, contract workers, or temporary staff, leading to an increase in working hours for the existing workforce. This suggests that the 2018 pension reform had a more profound effect on the labor market compared to the 2011 reform.

Secondly, the regression analysis of working hours indicates several significant factors influencing working hours. Education years, gender, age, and marital status were found to be correlated with working hours. Higher education levels were associated with shorter working hours, while females generally had longer working hours compared to males. Older individuals tended to work fewer hours, and married individuals had shorter working hours compared to unmarried individuals. These findings provide valuable insights into the determinants of working hours in the context of pension reforms and highlight the importance of considering demographic factors when analyzing labor market dynamics.

Additionally, the analysis of monthly wages in the 2011 and 2018 pension reforms shows that the 2018 reform had a significant decreasing effect on wages, while the 2011 reform did not produce a significant impact. The stricter eligibility criteria and reduced retirement benefits in the 2018 reform resulted in lower monthly wages.

Furthermore, education years, age, marital status, sex, major, and primary job were found to be significant factors influencing monthly wages. Higher education levels, older age, being married, and working in specific majors and jobs were associated with higher wages. Females, on the other hand, generally earned lower wages compared to males. These findings provide insights into the wage dynamics following pension reforms and highlight the importance of considering various demographic and occupational factors when analyzing wage trends.

In conclusion, the 2018 National Pension Reform had a significant impact on working hours and monthly wages, particularly for females. The reform led to an increase in working hours for the existing workforce due to the retirement wave and the government's efforts to fill the labor gap. Education, gender, age, and marital status were found to be important determinants of working hours, while factors such as education, age, marital status, sex, major, and primary job influenced monthly wages. These findings contribute to a better understanding of the labor market dynamics and the effects of pension reforms on different demographic groups. Policymakers can utilize these insights to formulate strategies that address the implications of pension reforms on employment and income levels.

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