# Evaluating the impact of an increase in retirement age under OLG Framework

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## Abstract

This paper investigates the effects of raising the retirement age through fiscal reforms aimed at improving sustainability by increasing the working population. It has been observed in recent decades that certain rich countries have been increasing their effective retirement age due to fiscal imbalance in government budget. Countries with higher per capita GDP generally have mandatory retirement ages above effective retirement ages, while some Asian countries show the opposite trend, reflecting differing perspectives on working age.

Literature classifies macro-level factors into push, pull, and retention factors influencing labour market participation. Recent reforms focus on reducing pull factors, which encourage early retirement. Studies show increasing the retirement age boosts labour force participation and decreases government health expenditures.

Extending Diamond's overlapping generation model, this paper examines how delayed retirement impacts labour participation, savings, consumption, social security contributions and pension substitution rate. The theoretical model uses a *pay-as-you-go* transfer scheme to understand the effects of an increase in retirement on economic variables.

A case study of France's 2010 pension reform compares it with Sweden's system. Using a difference-in-difference analysis, the study finds that increasing the retirement age reduces health expenditure and increases labour force participation. However, its effect on social contributions is unclear and does not align with the theoretical predictions.

The findings underscore the need for adaptive pension reforms to address aging population challenges, highlighting the complex interplay between policy changes and economic outcomes.

## Literature Review

Attempts to raise the retirement age and reverse the trend of early exit has led to fiscal reforms, which are particularly appealing from the point of view of sustainability as they decrease the expenditure incurred by reducing the number of beneficiaries and increasing the size of the working population. Due to various prominent reforms aimed at extending the working period of a cohort, there is a growing body of literature on the macro and micro-level implications of such policy change.

Countries with a per capita GDP greater than $22,000 (regarded as 'rich nations' by the World Bank) usually have mandatory retirement age equal to or greater than their effective retirement age counterparts. Asian countries show a different trend where the mandatory retirement age is equal to less than their effective retirement age. These could help us understand the difference in working age perspectives among the developed and the developing world.

The existing literature often categorizes macro-level factors as push, pull, and retention factors (Hofacker, 2013). The incentives provided in welfare systems that provide opportunities to leave work early are pull factors, which pose powerful incentives for rational individuals not to continue working above a minimum threshold.

A multitude of other factors play a role as well, often described as push factors, which include business cycle shifts and changing occupational structures that impede labour market participation chances for an older workforce. Lately, measures fostering older workers' labour market participation and combating push factors are described as retention factors.

However, recent reforms have focused on scaling down existing pull incentives, which is the main focus of this paper. The existing studies find that increasing the normal retirement age led to a significant increase in the labour force participation rate among the affected cohorts (Mastrobuoni, 2009), (Gruber, 1999)).

Moreover, retirement decisions are sensitive to incentives such as health expenditures incurred by the government (Coile, 2007). They provide insights into how a change in retirement age can affect overall government expenditures, suggesting a negative relationship between the two.

Furthermore, current studies suggest that increasing the retirement age can lead to higher social contributions and better fiscal outcomes and provide evidence that such policies increase social security revenues (Age, 2019) by increasing tax revenue, delaying pension payouts, and increasing the relative share of social contribution in government revenue.

This paper extends the overlapping generations model of (Diamond, 1965) by assuming that an old agent must work for a certain amount of time before retirement to receive the full amount of social security pension.

## Introduction

The aging population is one of the most significant ongoing social transformations. This demographic shift is characterized by a rising median age in the population, typically due to advances in healthcare, improved living standards, and better nutrition. This trend increases the dependency ratio, placing financial strain on the working population and social services.

Substantial pension reforms have been carried out over the last decades to enhance fiscal sustainability and respond to demographic pressure while maintaining adequate pension income. Most reforms include the alteration of key pension parameters (like the minimum pension age and financing resources).

Some stylized facts revolving around the trends are as follows:

1. In many developed countries, the pay-as-you-go social security system makes commitments that cannot be fulfilled without substantial reforms. Without these changes, the current systems are financially unsustainable. From the 1960s to the mid-1990s, there was a trend of older individuals exiting the workforce at increasingly younger ages. Retirement behaves as a normal good, meaning that the desire for retirement years increases as individuals' income rises.
2. Only a minor portion of the workforce retires before reaching the early eligibility age (EEA), generally set between 60 and 62 years old, when public retirement benefits become accessible. Likewise, few individuals continue working until reaching the normal retirement age (NRA), typically around 65 years old in many countries. Consequently, most individuals retire either at the EEA or somewhere between the EEA and NRA.
3. Many social security systems provide significant incentives for older workers to exit the workforce. In many countries, there is little financial incentive to continue working beyond the early eligibility age (EEA) because adjustments to benefits are typically less than actuarially fair. The expected present value of social security benefits decreases with retirement age, resulting in a substantial implicit tax on employment beyond the EEA.
4. In numerous European countries, disability programs and provisions for age-related unemployment effectively function as early retirement benefits, often available even before reaching the early eligibility age (EEA).

### *Mandatory v/s Effective Retirement Age*

We conducted a cross-country analysis (Data Source: World Bank, 2020).

The retirement landscape shows significant diversity across nations, influenced by a blend of economic policies and cultural norms. Studying retirement ages across 48 countries in 2020, as documented in the OECD 2021 report, provides illuminating insights into global labour force dynamics. The OECD defines the "current retirement age" as the threshold at which individuals can retire without facing pension penalties after completing a full career, starting from age 22. On the other hand, the "effective retirement age" denotes the average age at which workers aged 40 and older exit the workforce.

Numerous factors contribute to the variance between these measures across countries. Disparities in career start ages, sector-specific retirement incentives, and national policies, all play crucial roles. Certain industries may offer early retirement options or delayed commitments, influencing both retirement age metrics. Additionally, market demands and governmental regulations shape workforce exits, contributing to the retirement landscape observed globally. Personal considerations also weigh heavily, with individuals opting for early retirement due to personal preferences or limited job opportunities, potentially accepting reduced pensions or forgoing them altogether. Conversely, some choose to continue working if suitable employment is available.

The graphs presented are open-world maps constructed using Excel, offering a flexible and interactive display of geographical data. The blue map displays mandatory retirement ages across nations, with darker shades indicating higher ages of compulsory retirement. Notably, countries such as Australia, Israel, the United Kingdom, the United States, and Denmark feature among those with the highest mandatory retirement ages, while India, Turkey, and Bangladesh are the countries with a lower compulsory retirement age. In contrast, the green map displays effective retirement ages, with darker hues highlighting older average exit ages from the workforce. Australia, Costa Rica, Colombia, and India appear with higher effective retirement ages, contrasting with countries like Bangladesh, Luxembourg, Slovakia, and Thailand, which show lower effective retirement ages. An interesting observation arises involving India, which exhibits both one of the lowest mandatory and effective retirement ages globally. This indicates a tendency among its people to work beyond legally mandated retirement ages, influenced by economic factors and personal preferences.

Understanding these global retirement trends is essential for policymakers, economists, and individuals navigating retirement planning. These insights emphasize the complexity of retirement systems worldwide and highlight the need for adaptive policies that accommodate diverse economic, social, and individual circumstances. By leveraging comprehensive data analysis and visual tools like Excel-generated maps, we gain a deeper appreciation of the evolving dynamics shaping retirement around the world.

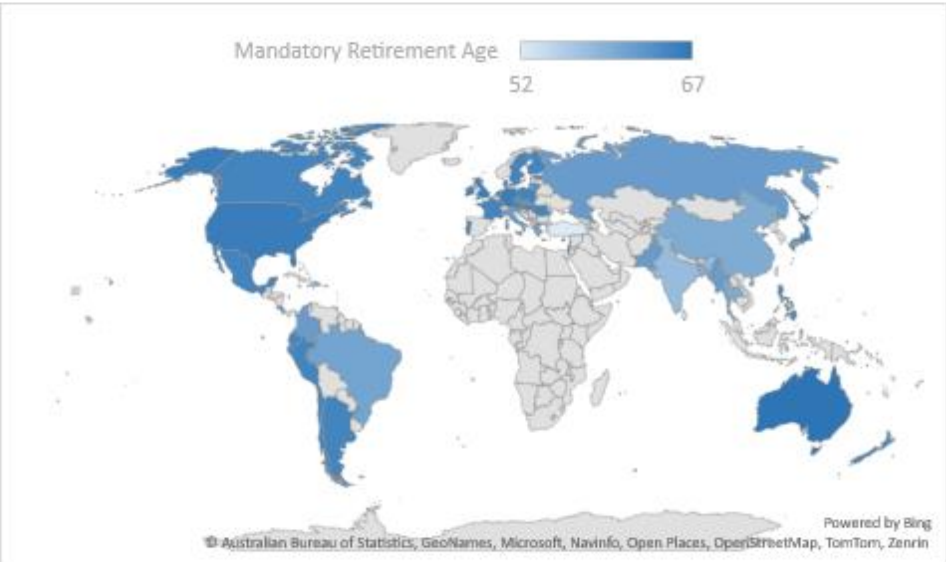


*Figure 1 Cross Country Analysis of Mandatory Retirement Age*


*Figure 2 Cross-Country Analysis of Effective Retirement*

## *Stylized Facts about the Prosperous Country*

Different criteria define developed countries, including classifications from organizations like the International Monetary Fund and the World Bank. Additionally, the Human Development Index (HDI) ranks nations based on life expectancy, education, and income per capita. Another widely used benchmark is a GDP per capita threshold of at least US$22,000. By identifying countries in our dataset with a GDP per capita exceeding this threshold as "prosperous", we analyse them using pivot tables in Excel. (Table A1)

A pivot table is a powerful tool for data summarization, allowing quick analysis and interpretation of vast datasets. It aggregates spreadsheet data into a concise, customizable format, enabling report generation, trend identification, and data-driven decision-making. Through simple drag-and-drop actions, we pivot data across rows and columns, apply calculations, and visualize outcomes via charts and graphs. This functionality empowers effective data analysis and visualization.

Thereafter, data is represented using a pivot chart, which dynamically summarizes and visualizes information derived from the pivot table (Appendix I) This graphical representation allows users to comprehend trends, patterns, and comparisons.

In our analysis, GDP per capita serves as the filter criterion while plotting mandatory and effective retirement ages against each other as row values. Results indicate that, excluding Japan and New Zealand, most prosperous countries have a mandatory retirement age equal to or greater than the effective retirement age. This behavioural and economic trend among wealthy nations suggests a preference for early retirement, reflecting higher standards of living and quality of life.

The Stylised Facts:

1. **Financial Security**: Many individuals in wealthy nations have strong retirement savings, investments, and pension plans that allow them to afford early retirement without financial strain. They may have accumulated sufficient wealth during their working years to support a comfortable retirement.
2. **Improved Quality of Life**: Rich countries often offer a higher standard of living, which can include better healthcare, social services, and overall quality of life. Retiring early allows individuals to enjoy these benefits while they are still healthy and active.
3. **Career Fatigue**: In demanding professions or industries with high-stress levels, individuals may choose to retire early to escape job-related stress and pursue other interests or hobbies. This can lead to a better work-life balance and improved mental well-being.
4. **Generous Retirement Benefits**: Some countries and companies in wealthy nations offer generous retirement packages, including early retirement incentives or pensions that encourage employees to retire before the official retirement age.

5. **Longevity and Health**: With access to advanced healthcare and longer life expectancies, people in rich countries may retire early to prioritize their health and longevity, allowing them to enjoy retirement years in good health.
6. **Changing Workforce Dynamics**: Advancements in technology and automation may lead to job redundancies or career shifts, prompting individuals to consider early retirement as a strategic career move or to explore new opportunities.
7. **Cultural and Social Factors**: Societal norms and cultural attitudes towards retirement in affluent countries may value leisure time and personal fulfilment, prompting individuals to retire early to pursue personal interests, travel, or spend more time with family.

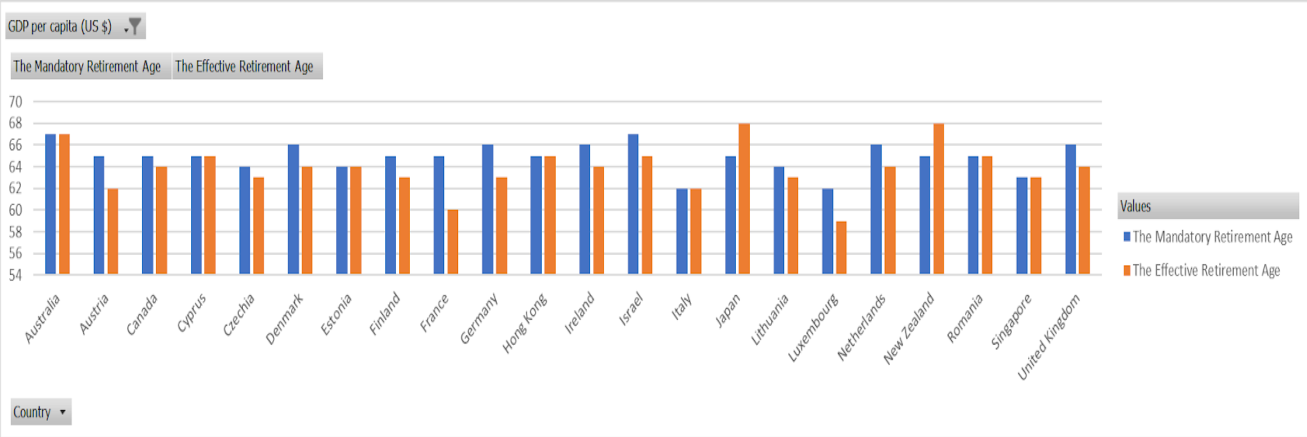


*Table 1 Pivot Graph*

## The Asian Retirement Story

Using the data sourced from the World Bank on retirement ages (Appendix ii) and narrowing it down to Asian countries, helps in analysing a specific picture of the fast-growing developing nations.
Considering 11 Asian countries, most of them show a similar trend where the mandatory retirement age is less than equal to the effective retirement age, signifying that Asian people tend to work longer in life due to several cultural, economic, and societal factors:

1. **Financial Considerations**: In many Asian countries, particularly in rapidly developing economies like China, Japan, and South Korea, there is a strong emphasis on financial security and providing for one's family. Therefore, individuals may choose to work longer to accumulate sufficient savings and ensure a stable financial foundation for retirement.
2. **Social Expectations**: In Asian cultures, there is often a sense of responsibility towards family and society. Older generations may feel obligated to continue working to support their children or extended family members financially and maintain their social standing.
3. **Longevity and Health**: With advancements in healthcare and improved living conditions, people in Asian countries are living longer. This longevity may lead individuals to extend their working years to support a longer retirement period and maintain their quality of life during retirement.
4. **Limited Social Safety Nets**: Some Asian countries may have less developed social safety nets or pension systems compared to Western countries. This lack of adequate retirement benefits incentivizes individuals to remain in the workforce longer to secure their financial future independently.
5. **Work Ethic and Dedication**: Asian cultures often value hard work, dedication, and lifelong learning. Older workers may be respected for their experience and wisdom, leading them to continue contributing to the workforce and mentoring younger colleagues.
6. **Career Opportunities and Job Security**: Employment opportunities and job security can influence retirement decisions. In competitive job markets like Japan and South Korea, where seniority and experience are highly valued, older workers may find it advantageous to remain employed as long as possible.
7. **Government Policies**: Government policies and retirement age regulations vary across Asian countries. Some governments have gradually increased the official retirement age in response to demographic changes, encouraging longer workforce participation.

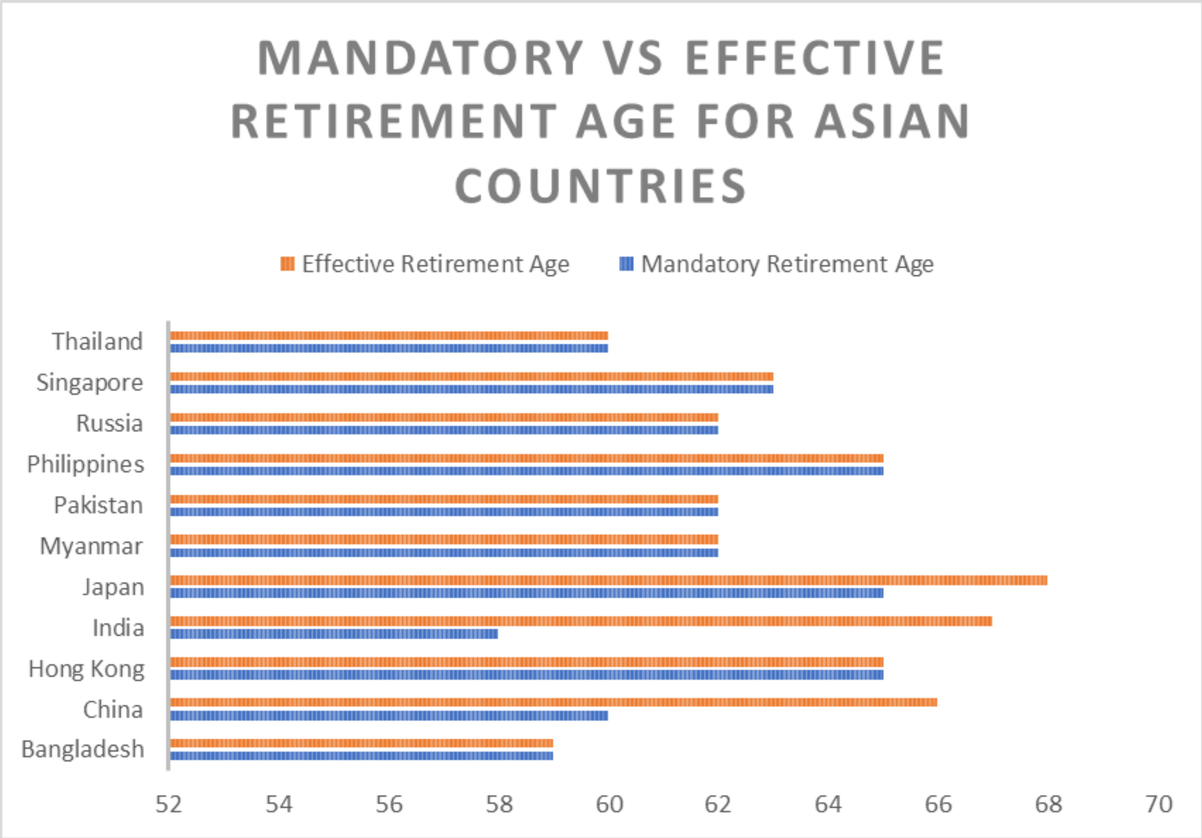


*Figure 3 Asian Countries Analysis*

### *Factors Affecting the Mandatory Retirement Age*

Using the World Bank dataset for 47 countries on parameters: Productivity: output per hour worked, GDP per capita (US $), Mandatory Retirement Age, Labour Force Participation Rate, and Gross Savings (% of GDP), a heatmap is created using Python's Seaborn library. A heatmap is a graphical representation of data where the individual values in a matrix are represented as colours. Heatmaps are useful for visualizing large dataset's correlations, distributions, and patterns. Interpreting a heatmap involves understanding how data values are represented visually using colour gradients. Heatmaps are useful for visualizing relationships or patterns in data, especially when dealing with large datasets or correlation matrices. The diagonal of the heatmap represents the correlation of a variable with itself and is therefore one.

The analysis reveals several significant relationships: a strong correlation between productivity (output per hour worked) and GDP per capita (US $), as well as between labour force participation rate and productivity. Additionally, there is a notable correlation between the labour force participation rate and the mandatory retirement age. Our focus variable, mandatory retirement age, shows positive correlations with productivity and labour force participation rate. It exhibits a weak positive correlation with GDP per capita and a weak negative correlation with Gross Savings.

Given the diverse characteristics of the data across different regions, we refined our analysis to focus on the Asia-Pacific region and included additional variables. These updated variables include Country, Percentage of the Labor Force, Percentage of Recipient Pension Coverage, Productivity (output per hour worked), GDP per capita (US $), Mandatory Retirement Age, Labor Force Participation Rate, and Gross Savings (% of GDP).


*Figure 4 Heatmap for 47 Countries*

The updated heatmap provides clearer insights. Mandatory retirement age shows a positive correlation with GDP per capita and the percentage of the labour force. It demonstrates a weak positive correlation with productivity and labour force participation rate and a weak negative correlation with Gross Savings. These findings highlight the complex interplay between retirement policies, economic indicators, and labour market dynamics in the Asia-Pacific region.

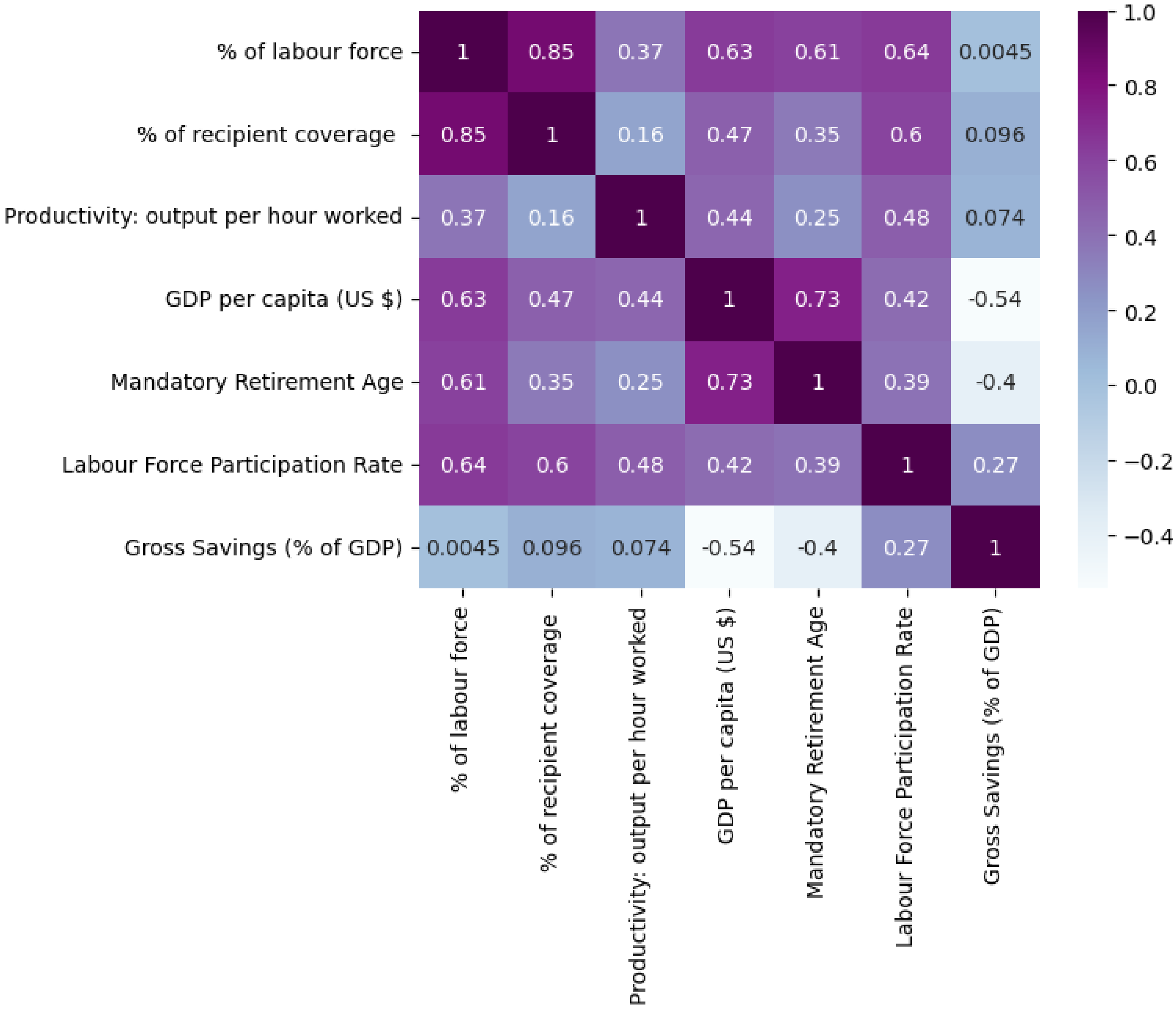


*Figure 5 Heatmap for OECD Countries*

## The model

*Consumer's behavior*

We use the overlapping generations (OLG) framework to understand the effects of change in the retirement age on labor force participation, lifetime savings and consumption decisions, social security contributions, and how intergenerational conflicts play in the role of redistributive policies by the government.

The agents maximize their lifetime (separable) utility function subject to the period-wise budget constraints. Each agent lives for two periods: 'youth' and 'old age' and at any point in time, the economy is composed of two cohorts, the young and the old. Individuals work only in the first period of their lives and supply one unit of labor inelastically. The agent works during the first period of their life and retires in the second period. An increase in the retirement age effectively extends the agent's working years and reduces the duration of their retirement. The model can be extended to examine how changes in the retirement age affect the provisions the agent makes for old age consumption from their first-period income. To do this, we assume the existence of a social security system that operates on a *pay-as-you-go* basis. This unfunded system transfers contributions made by the current young generation directly to the current old generation. Let $d_t$ be the contribution of a young person at a time t, and let $b_t$ be the benefits received by an old person at time t. The *pay-as-you-go* system suggests that $b_t = (1 + n)d_t$ where n is the growth rate of the population. The rate of return here is $n$ because in each period there are more contributions to the social security system as the population of the current young is higher than the population of the current old. Therefore, in this pay-as-you-go transfer scheme, the growth rate of the population essentially determines the benefits received by the current old generation. More young workers mean higher contributions, which directly increase the benefits for retirees.

To incorporate the effect of a delayed retirement age, we consider a model with two stages: full-time employment during the young age and partial employment during the old age. The agent's maximization problem is:

$$Max\ U_t\left(c_{1,t}, c_{2,t+1}\right) = lnc_{1,t} + \beta lnc_{2,t+1}\ ; 0 < \beta < 1 \qquad (1)$$

$$\text{s.t. } c_{1,t} + s_t = w_t(1-\tau) \qquad (2)$$

$$c_{2,t+1} = R_{t+1}s_t + z(1-\tau)w_{t+1} + (1-z)P_{t+1} \qquad (3)$$

$U_t$ is the individual's lifetime utility; $c_{1,t}$ and $c_{2,t+1}$ are individual's consumption during adulthood and old age respectively, $\beta$ is the discount factor, $R_{t+1}$ is the gross return on capital, and $P_{t+1}$ represents the pension received in old age. $z$ is a variable belonging to $[0,1]$ which incorporates delays in the retirement age.

Equation (1) is the agent's separable logarithmic utility function which depends on consumption during the two periods. Equation (2) is the first-period budget constraint. The agent earns wages during their young age and contributes to social security at a rate $\tau$, and saves a portion of their income for retirement. Equation (3) is the second-period budget constraint and incorporates the effects of changes in the retirement age. The agent earns interest on savings made in the first period and earns wages in old age following an increase in the retirement age; the term $z(1-\tau)w_{t+1}$ represents disposable wages earned during old age. The agent pays the social security contributions during the old age before retirement as well. The model manifests late retirement as an increase in $z$ during old age and decrease in the retirement age $(1-z)$. The constraints are altered to incorporate the changes in the retirement age.

The solution to the above optimization exercise is:

$$c_{1,t} = \frac{w_t(1-\tau)}{1+\beta} + \frac{1}{1+\beta}\left[\frac{z(1-\tau)w_{t+1}+(1-z)P_{t+1}}{R_{t+1}}\right] \qquad (i)$$

$$c_{2,t+1} = \frac{\beta R_{t+1}}{1+\beta}w_t(1-\tau) + \frac{\beta}{1+\beta}\left(z(1-\tau)w_{t+1} + (1-z)P_{t+1}\right) \qquad (ii)$$

$$s_t = \frac{\beta w_t(1-\tau)}{1+\beta} + \frac{1}{1+\beta}\left[\frac{z(1-\tau)w_{t+1}+(1-z)P_{t+1}}{R_{t+1}}\right] \qquad (iii)$$

The population is assumed to grow at a constant rate within a period. The population consists of two simultaneous generations in each period. The population grows at a constant exogenous rate n and therefore the increase in population from $t-1$ to $t$ is$N_t = (1+n)N_{t-1}$. Therefore, the growth rate of the population implies that $N_{1,t} = nN_{2,t}$ which simply says that the current young is n times more than the current old.

The transfer scheme implies that due to the population growth rate, the government can provide more benefits to the current old as the current young are higher in number. The current young would agree to such a transfer scheme because they know that they will get a similar transfer scheme when they are old. The agents will internalize the transfer scheme and cut down on their private savings as the transfer scheme takes care of part of the old-age consumption scheme.

The section below calculates the pension received in old age by an atomistic agent.

*Social security constraint*

The government collects the social security surplus from the current young and passes it on to the current old generation. The government maintains a balanced budget in this *pay-as-you-go* system. This implies that the total contributions collected from the current young workers, along with the contributions from those who continue working due to the increased retirement age, must equal the pension benefits paid out to individuals during their retirement. This gives us the following constraint:

$$\tau w_t N_{1,t} + z\tau w_t N_{2,t} = (1-z)P_t N_{2,t} \quad (4)$$

Notice that the subscript t suggests that the income is transferred from the current young generation to the current old generation in period t. The first term on the left-hand side of the equation is the social contribution collected from the agents while young and the second term on the left-hand side is the social security contribution of the elderly labour working due to an increase in retirement age.

Solving equation (4) for pension received $P_t$ and using the exogenous population rate, we get:

$$\tau w_t n N_{2,t} + z\tau w_t N_{2,t} = (1-z)P_t N_{2,t}$$

$$\tau w_t n + z\tau w_t = (1-z)P_t$$

$$P_t = \frac{\tau w_t(n+z)}{1-z} \quad (5)$$

Substituting (5) in savings obtained above in (iii):

$$s_t = \frac{\beta w_t(1-\tau)}{1+\beta} - \frac{z(1-\tau)w_{t+1} + \tau w_t(n+z)}{R_{t+1}(1+\beta)} \quad (iv)$$

*Firm's behavior*

It is assumed that there are many homogenous firms in a perfectly competitive market. All the firms have identical production functions and take Cobb-Douglas form with constant returns to scale:

$$Y_t = K_t^\alpha L_t^{1-\alpha}$$

$Y_t, K_t, and\ L_t$ are output, capital, and labour and $\alpha$ is the elasticity of capital. The firm maximizes profit:

$$\pi = K_t^\alpha L_t^{1-\alpha} - [(1+\tau)w_t L_t + R_t K_t]$$

Using profit maximization, and the first order conditions, the wages and rental rate are:

$$w_t = \frac{(1-\alpha)k_t^\alpha}{1+\tau} \quad (6)$$

$$R_t = \alpha k_t^{(1-\alpha)} \quad (7)$$

*General equilibrium*

The capital accumulation for the economy will be obtained by aggregating savings over the entire population of the young generation and people who continue working due to delayed retirement. At any given point, the working population consists of $N_t = N_{1,t} + zN_{2,t}$. Therefore, when the capital market clears $K_{t+1} = N_{1,t}s_t$. Converting this in per capita terms:

$$k_{t+1} = \frac{K_{t+1}}{N_{t+1}}$$

$$k_{t+1} = \frac{N_{1,t}s_t}{n(N_1,t + zN_{2,t})} = \frac{nN_{2,t}s_t}{n(nN_2,t + zN_{2,t})}$$

$$k_{t+1} = \frac{s_t}{(n+z)} \quad (8)$$

Substituting (6), (7), and (8) in (iv), we find the dynamic equation of the capital-labour ratio for the atomistic agent at the steady state where $k_{t+1} = k_t = k^*$ and $w_{t+1} = w_t = w^*$:

$$k^* = \left[\frac{\beta\alpha(1-\tau)(1-\alpha)}{\alpha(1+\beta)(n+z)(1+\tau)+(1-\alpha)(z+\tau n)}\right]^{\frac{1}{1-\alpha}} \qquad (9)$$

$$y^* = \left[\frac{\beta\alpha(1-\tau)(1-\alpha)}{\alpha(1+\beta)(n+z)(1+\tau)+(1-\alpha)(z+\tau n)}\right]^{\frac{\alpha}{1-\alpha}} \qquad (10)$$

*Comparative statics*

To test for comparative statistics, we define a variable to determine the adequacy of retirement income. It represents the ratio of a person's pension income to pre-retirement earnings. The pension substitution rate is:

$$R_t = \frac{P_{t+1}}{\frac{(w_t+zw_{t+1})}{1+z}}$$

Substitute (5) and (6) in (11), we get the pension substitution rate:

$$R^* = \frac{\tau(n^*+z)}{1-z} \qquad (11)$$

Comparative statics results are obtained using the above equations. To test for the impact of the increase in retirement age on social security contribution:

$$\frac{\partial\tau}{\partial z} = \frac{-R[n+1]}{(n+z)^2}<0$$

Similarly, an increase in retirement age reduces the per capita income and capital-labour ratio. Intuitively, since people work for a longer time, savings in the economy are reduced, and this in turn reduces $k\ and\ y$. Therefore, we get:

$$\frac{\partial y}{\partial z} < 0;\ \frac{\partial k}{\partial z} < 0$$

Lastly, the impact of the increase in the Social Security rate $\tau$ on pension substitution rate is positive. This implies that:

$$\frac{\partial R}{\partial \tau} > 0$$

The following results are obtained using comparative statistics:

**R1**: Increase in retirement age reduces the social security contribution rate

**R2**: Increase in retirement age reduces per capita income and savings in the economy.

**R3**: An increase in retirement age increases the pension substitution rate and thereby increases the labour force participation rate.

## *France Case study*

In France, the age dependency ratio (% of the working population) increased from 54% in 2000 to 64% in 2022. Projections indicate that by 2030, the proportion of individuals over 65 will surpass those under 20 for the first time. In Western societies, the transition from work to retirement is now a common experience, with the retirement phase lasting longer than ever. Addressing an aging population's challenges and opportunities requires comprehensive and multifaceted strategies across economic, social, and technological domains.

We evaluate the 2010 pension reform in France under the overlapping generation framework, which includes a realistic description of the mortality process.

### *Context to pension reforms*

Pension reform represents a critical component of social policy, intricately intertwined with economic and demographic shifts. Within the landscape of pension reform, advanced European economies like France and Sweden offer illuminating contrasts in their strategic approaches. France recently focused on modifications to the minimum retirement age in pivotal moments such as 2010 and 2023, while Sweden stands out as a noteworthy case study in comparative analysis.

### *France's Pension System Dynamic*

France's pension system, renowned for its generosity and anchored in a PAYG structure, has encountered formidable sustainability challenges in the face of shifting demographics. Noteworthy developments include President Sarkozy's landmark decision in 2010 to raise the minimum retirement age to 62, a response aimed at addressing pressing financial concerns. However, this move was met with resounding protests, indicative of the fervent public resistance. President Macron's subsequent endeavour in 2023 to further elevate the retirement age to 64 evoked similar opposition, underscoring the inherent complexities and opposition entwined with enacting crucial reforms in this domain.

### *Sweden's Progressive Pension Paradigm*

In stark contrast, Sweden embarked on a transformative trajectory in reshaping its pension landscape during the 1990s, transitioning towards an innovative NDC system characterized by its adaptive retirement age provisions and the incorporation of automatic adjustments hinged on demographic trends. This forward-thinking approach has enjoyed broader societal support, as it underscores the foundations of adaptability and sustainability seamlessly integrated within the structural fabric of the pension system.

Deconstructing pension reform from theoretical perspectives accentuates the delicate balance between ensuring adequacy and nurturing sustainability within the pension ecosystem. The theoretical frameworks of the life-cycle hypothesis and labour supply theory serve as guiding beacons in understanding individual reactions to shifts in retirement age policies. These theoretical underpinnings shed light on how alterations in retirement age thresholds may reverberate across individuals' savings behaviour and labour market engagement in the twilight years leading up to retirement.

The political economy surrounding pension reform is a labyrinthine terrain, necessitating adept navigation through the intricate web of divergent stakeholder interests spanning current workers, retirees, and future generations. The tenets of public choice theory posit that enacting reforms often encounters formidable challenges due to the concentrated burdens borne by present-day workers juxtaposed against the diffuse benefits awaited by subsequent generations.

France and Sweden emerge as compelling case studies showcasing contrasting paradigms in pension reform, emblematic of the distinct socio-economic contexts that shape their reform trajectories. While France grapples with steadfast resistance towards amending retirement age benchmarks, Sweden epitomizes a pioneering model of adaptability and sustainability that underscores the multifaceted challenges entrenched within pension reform.

### *Macroeconomic view*

1. Debt to GDP ratio

France is known for maintaining a substantial level of mandatory levies, including taxes and social security contributions, which are crucial for funding its extensive welfare state and public services, resulting in an uninterrupted growth of the Central Government's debt-to-GDP ratio over the past years.

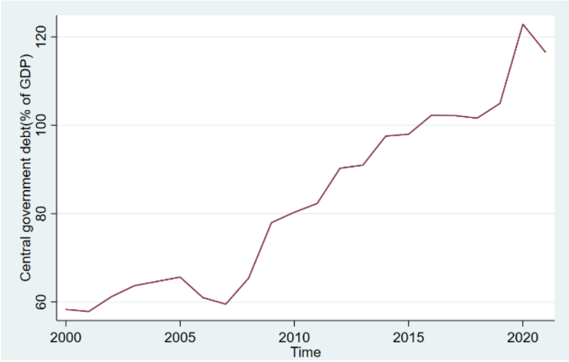


*Figure 6: Debt to GDP Ratio*

2. Dependency Ratio

The percentage of older people has increased rapidly relative to the number of younger persons and the trends continued. Along with this, agents are living longer.

The combined effect of an aging population and increasing longevity has drastic labour market implications.

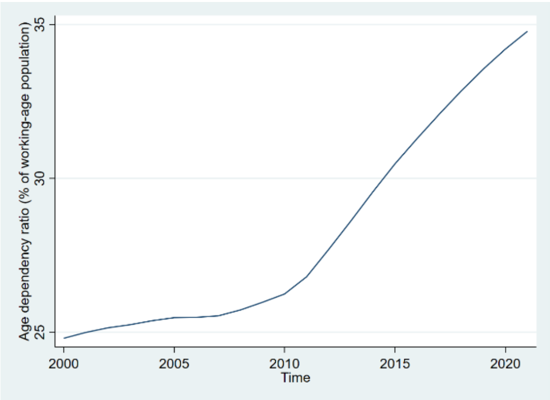


*Figure 7 Dependency Ratio*

Demographic shifts influence economic growth, productivity, and fiscal sustainability, necessitating adaptive policies in pension systems, healthcare, and workforce planning.

### *Empirical Evidence*

We conduct a difference-in-difference casual analysis, where the treatment group is France, which undertook a pension reform policy. It increased its minimum retirement age from 60 to 62 years in response to its rising debt-to-GDP ratio, effective from 2010 onwards, and the control group is Sweden, which has a stable retirement policy.

Sweden and France are high-income, well-developed economies with a strong welfare system and comprehensive healthcare systems. Both countries faced the compound problem of aging populations and longevity, which put a brake on further improvements in living standards and led to unsustainable increases in social expenditures in the long run.

Further, in 2023, both countries went through a pension reform that increased the minimum retirement age. With such demographic similarities, while controlling for confounding factors, the fundamental difference is the pension scheme structure.

The treatment variable is retirement age, which captures the fiscal policy intervention.

Further, the dependent variables are labour force participation rate (% of total population ages 15–64), health expenditures incurred by the government, and social contribution (% of revenue). They satisfy the key assumption of parallel trends, which posits that, in the absence of treatment, the average outcomes for the treatment group and the control group would follow parallel paths over time. A similar test was conducted for savings (% of GNI) and Compensation of Employees (% of expenses), which however failed the parallel test assumption.

Certain controls were also taken into account to capture the fixed effect. The vector of controls includes age dependency ratio, old age (% of working-age population), central government debt, total (% of GDP), life expectancy at birth, total (years), population growth (annual% growth), consumer price index, and GDP per capita.

**Empirical Specification**

$$Y_{it} = \beta_1 Post_t + B_2 Treat_t + B_3(Post_t \times Treat_i) + \gamma X_{it} + \epsilon_{it}$$

Where $Y_{it}$ is the dependent variable for the country $i$ at period $t$. The independent dummy $Post_t$ takes the value 1 for post-treatment period periods; the variable varies over time. The second dummy variable $Treat_i$ takes the value 1 after the retirement age has been altered. The interaction term, $Post_t \times Treat_i$, which is the coefficient of our interest, represents the effect of retirement age in the treatment group. Finally, $X_{it}$ is the vector of control variables.

$H_0^1$: An increase in the minimum retirement age negatively affects health expenditure.

The intervention occurred in 2009, separating the pre-intervention period and the post-intervention period. As evident from Figure 8, the health expenditure in France was higher than in Sweden before policy intervention, however, after an increase in retirement age (change in z variable), the gap between the two nations narrowed down. Therefore, the interaction term (average treatment effect on the treated) has a negative and significant sign (at a 10% level of significance). (Table A1)

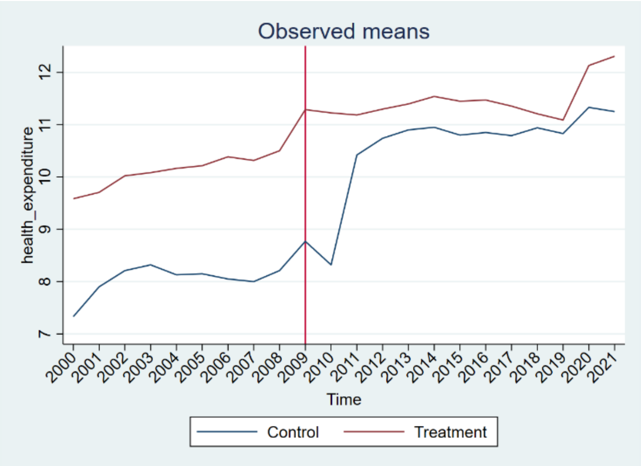


*Figure 8 Comparison of Effect of Treatment on Health Expenditure in Control and Treated Group*

The graph displays the observed means of health expenditure over time for our control group (Sweden) and treatment group (France), spanning the years from 2000 to 2021.

$H_0^2$: An increase in the retirement age positively affects LFPR.

The graph Figure 9 indicates a differential impact of the intervention on the treatment group compared to the control group, with the treatment group showing more significant changes in labour force participation rates post-intervention. The observed trends suggest that the intervention had a positive effect on LFPR for the treatment group, especially noticeable in the later years of the study period. Further, any difference in trends between the groups before the intervention is attributable to factors other than the treatment.
In Table A2, we observe the ATET is positive and significant at a high level of significance, aligning with the existing literature.

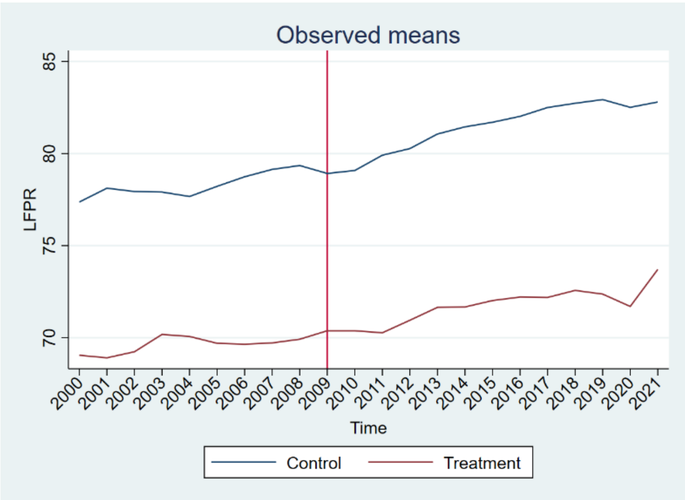


*Figure 9 Comparison of Effect of Treatment on LFPR in Control and Treated Group*

$H_0^3$: Social Contribution has a positive relation with an increase in retirement age.

Intuitively, we assume that delayed pension payouts and increasing tax revenue would increase social contribution (as a % age of revenue) however, we find positive but insignificant results (p-value> 0.240, Table A3) and is evident from the figure 10, that change in retirement policy has no impact on social contribution in the treated group. One possible explanation could be that the actual implementation of the policy to raise the retirement age may be incomplete or delayed, leading to a slower-than-expected increase in social contributions.

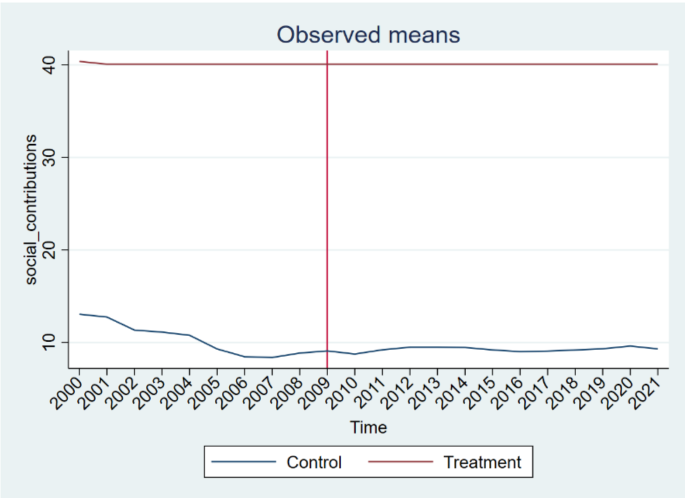


*Figure 10 Comparison of Effect of Treatment on Social Contribution in Control and Treated Group*

Limitation:
While running the DiD, we omitted some observations due to the problem of collinearity, even after controlling for fixed effects. One plausible explanation could be the various social security reforms undertaken targeting different aspects of pension policy, which due to the limited scope of our study were not captured adequately. However, the results remain robust and align with the existing literature.

## Conclusion

This paper has explored the multifaceted effects of raising the retirement age on labour force participation, health expenditure, and social contributions within the Overlapping Generations (OLG) framework. By extending Diamond's model and utilizing a Difference-in-Difference (DiD) analysis, we have provided empirical evidence supporting the hypothesis that increasing the retirement age positively impacts labour force participation and reduces health expenditures.

Our findings from the case study of France's 2010 pension reform align with existing literature, indicating significant increases in labour force participation rates and notable reductions in health expenditures post-reform. These results underscore the effectiveness of such reforms in promoting economic sustainability through extended workforce participation. However, the expected positive relationship between retirement age and social contributions remains ambiguous, as our analysis revealed positive but statistically insignificant results. This discrepancy suggests potential implementation delays or incomplete execution of the policy, warranting further investigation.

The broader implications of our study highlight the need for adaptive pension reforms that can accommodate the dynamic economic and demographic landscapes. As countries face the challenges of aging populations, policymakers must consider comprehensive strategies that not only extend the working age but also address the underlying socio-economic factors influencing retirement decisions.

In conclusion, raising the retirement age appears to be a viable policy tool for enhancing labour market participation and reducing public health expenditures, contributing to greater fiscal sustainability. Future research should focus on exploring the long-term effects of such reforms and identifying additional factors that can influence their success. This study adds to the growing body of literature advocating for well-designed pension policies that balance economic imperatives with the well-being of the aging population.

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Appendix:

Mandatory and Effective Retirement age (Dataset: World Bank)

| GDP per capita (US $) | (Multiple Items) | |
|---|---|---|
| | | |
| **Row Labels** | **The Mandatory Retirement Age** | **The Effective Retirement Age** |
| Australia | 67 | 67 |
| Austria | 65 | 62 |
| Canada | 65 | 64 |
| Cyprus | 65 | 65 |
| Czechia | 64 | 63 |
| Denmark | 66 | 64 |
| Estonia | 64 | 64 |
| Finland | 65 | 63 |
| France | 65 | 60 |
| Germany | 66 | 63 |
| Hong Kong | 65 | 65 |
| Ireland | 66 | 64 |
| Israel | 67 | 65 |
| Italy | 62 | 62 |
| Japan | 65 | 68 |
| Lithuania | 64 | 63 |
| Luxembourg | 62 | 59 |
| Netherlands | 66 | 64 |
| New Zealand | 65 | 68 |
| Romania | 65 | 65 |
| Singapore | 63 | 63 |
| United Kingdom | 66 | 64 |
| **Grand Total** | **1428** | **1405** |

*Appendix i Mandatory and Effective Retirement Age*

| Country | Mandatory Retirement Age | Effective Retirement Age |
|---|---|---|
| Bangladesh | 59 | 59 |
| China | 60 | 66 |
| Hong Kong | 65 | 65 |
| India | 58 | 67 |
| Japan | 65 | 68 |
| Myanmar | 62 | 62 |
| Pakistan | 62 | 62 |
| Philippines | 65 | 65 |
| Russia | 62 | 62 |
| Singapore | 63 | 63 |
| Thailand | 60 | 60 |

*Appendix ii Retirement Age in Asian Countries*

| Countr y | Productivity: output per hour worked | GDP per capita (US $) | Mandatory Retirement Age | Labour Force Participation Rate | Gross Savings (% of GDP) |
|---|---|---|---|---|---|
| Argentina | 29.42588 | 13650.60463 | 65 | 63.7 | 14 |
| Australia | 61.438488 | 65099.84591 | 67 | 77.7 | 22 |
| Austria | 65.15168 | 52084.6812 | 65 | 77 | 28 |
| Banglade | 47.91032 | 2688.305501 | 59 | 60.4 | 36 |
| Brazil | 19.195236 | 8917.674911 | 61 | 66.6 | 12 |
| Canada | 57.244343 | 55522.44569 | 65 | 77.7 | 20 |
| Chile | 28.418756 | 15355.47974 | 65 | 63.1 | 20 |
| China | 11.692401 | 12720.21632 | 60 | 74.3 | 44 |
| Colombia | 16.958618 | 6624.165393 | 62 | 68.3 | 16 |
| Costa Ric | 20.024153 | 13365.3564 | 62 | 66.7 | 14 |
| Cyprus | 42.394142 | 32048.24023 | 65 | 73.8 | 14 |
| Czechia | 40.932842 | 27226.61564 | 64 | 76.5 | 27 |
| Denmark | 76.00354 | 67790.05399 | 66 | 78.7 | 30 |
| Dominica | 17.53021 | 10111.24571 | 60 | 63.8 | 24 |
| Ecuador | 15.255215 | 6391.282484 | 65 | 63.5 | 26 |
| Estonia | 37.103794 | 28247.09599 | 64 | 79.1 | 29 |
| Finland | 58.440796 | 50871.93045 | 65 | 78.1 | 24 |
| France | 68.63126 | 40886.25327 | 65 | 71.7 | 24 |
| Germany | 68.8512 | 48717.99114 | 66 | 78.7 | 30 |
| Greece | 33.032787 | 20867.26909 | 62 | 66 | 10 |
| Hong Kor | 49.118412 | 48983.62172 | 65 | 72.6 | 24 |
| Hungary | 34.83344 | 18390.185 | 65 | 72.8 | 27 |
| India | 8.680879 | 2410.888021 | 58 | 53.2 | 30 |
| Ireland | 12.509254 | 103983.2913 | 66 | 71.9 | 35 |
| Israel | 40.870785 | 54930.93881 | 67 | 71.5 | 27 |
| Italy | 56.090836 | 34776.42323 | 62 | 64.4 | 21 |
| Japan | 42.56412 | 34017.27181 | 65 | 80.3 | 29 |
| Lithuania | 34.452484 | 25064.80891 | 64 | 78.5 | 21 |
| Luxembou | 80.32644 | 125006.0218 | 62 | 72.9 | 18 |
| Mexico | 20.339481 | 11496.52287 | 65 | 60.6 | 21 |
| Netherlan | 69.77961 | 57025.01246 | 66 | 81.3 | 29 |
| New Zeal | 44.547375 | 48418.59166 | 65 | 81 | 21 |
| Pakistan | 8.772413 | 43476.37804 | 62 | 53.9 | 11 |
| Peru | 11.008161 | 16003.09753 | 65 | 72.2 | 21 |
| Philippine | 9.929681 | 1588.879829 | 65 | 56.9 | 32 |
| Poland | 37.07774 | 3498.509806 | 65 | 71 | 20 |
| Portugal | 35.147415 | 1558.021277 | 65 | 74.2 | 18 |
| Romania | 34.723377 | 50482.11313 | 65 | 68.9 | 19 |
| Russia | 29.547054 | 18984.8511 | 62 | 74.2 | 27 |
| Singapore | 54.55258 | 30447.88371 | 63 | 77.3 | 41 |
| Slovakia | 35.82719 | 14684.05791 | 63 | 72.7 | 21 |
| Slovenia | 42.50005 | 2386.696176 | 62 | 74.8 | 27 |
| Sweden | 65.53587 | 5858.824661 | 65 | 82.5 | 30 |
| Thailand | 15.167234 | 10065.03475 | 60 | 75.1 | 32 |
| Turkey | 43.692204 | 1701.245382 | 52 | 54 | 26 |
| United Kir | 54.34881 | 46125.25575 | 66 | 78 | 16 |
| United Sta | 73.7004 | 4533.975586 | 66 | 71.7 | 20 |

*Appendix iii World Bank dataset for 47 countries on various parameters*

| Country | % of labour force | % of recipient coverage | Productivity: output per hour worked | GDP per capita (US $) | Mandatory Retirement Age | Labour Force Participation Rate | Gross Savings (% of GDP) |
|---|---|---|---|---|---|---|---|
| Australia | 100 | 100 | 61.438488 | 65099.84591 | 67 | 77.7 | 22 |
| China | 85.4 | 100 | 11.692401 | 12720.21632 | 60 | 74.3 | 44 |
| Hong Kong | 83.2 | 73.2 | 49.118412 | 48983.62172 | 65 | 72.6 | 24 |
| India | 31.5 | 42.5 | 8.680879 | 2410.888021 | 58 | 53.2 | 30 |
| Indonesia | 24 | 14.8 | 86.55 | 4788 | 58 | 69.8 | 37 |
| Japan | 100 | 100 | 42.56412 | 34017.27181 | 65 | 80.3 | 29 |
| Korea | 77.8 | 100 | 40.77 | 32422.57 | 60 | 65.4 | 34 |
| Malaysia | 48.7 | 18.6 | 24.75 | 11993.19 | 60 | 69.3 | 27 |
| New Zealar | 100 | 100 | 44.547375 | 48418.59166 | 65 | 81 | 21 |
| Pakistan | 10.9 | 5.8 | 8.772413 | 43476.37804 | 62 | 53.9 | 11 |
| Philippine: | 37.3 | 20.5 | 9.929681 | 1588.879829 | 65 | 56.9 | 32 |
| Singapore | 56.8 | 33.1 | 54.55258 | 30447.88371 | 63 | 77.3 | 41 |
| Sri Lanka | 44.6 | 35.7 | 18.02 | 3354.38 | 60 | 53.6 | 26 |
| Thailand | 42 | 89.1 | 15.167234 | 10065.03475 | 60 | 75.1 | 32 |
| Vietnam | 26.2 | 40.9 | 6.74 | 4163.51 | 60 | 75.2 | 36 |

*Appendix iv World Bank dataset for OECD on various parameters*

The following are the results obtained after running difference-in-difference:

a) Health Expenditure

```
Difference-in-differences regression                    Number of obs = 44
Data type: Longitudinal

                                   (Std. err. adjusted for 2 clusters in Country)
---------------------------------------------------------------------------------
                    |               Robust
 health_expenditure | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
--------------------+------------------------------------------------------------
ATET                |
      retirement_age |
           (1 vs 0) |  -.2850892   .0304058    -9.38   0.068    -.6714315    .1012531
---------------------------------------------------------------------------------
Note: ATET estimate adjusted for covariates, panel effects, and time effects.
```

*Table A1 Health Expenditure*

b) Labour Force Participation Rate

```
Difference-in-differences regression                    Number of obs = 44
Data type: Longitudinal

                                   (Std. err. adjusted for 2 clusters in Country)
---------------------------------------------------------------------------------
                    |               Robust
               LFPR | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
--------------------+------------------------------------------------------------
ATET                |
      retirement_age |
           (1 vs 0) |    .780835   .0190839    40.92   0.016     .5383508    1.023319
---------------------------------------------------------------------------------
Note: ATET estimate adjusted for covariates, panel effects, and time effects.
```

*Table A2 Labour Force Participation Rate*

c) Social Contribution

```
Difference-in-differences regression                    Number of obs = 44
Data type: Longitudinal

                                   (Std. err. adjusted for 2 clusters in Country)
---------------------------------------------------------------------------------
                    |               Robust
social_contributions | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
--------------------+------------------------------------------------------------
ATET                |
      retirement_age |
           (1 vs 0) |   9.143642    3.62672     2.52   0.240    -36.9382    55.22549
---------------------------------------------------------------------------------
Note: ATET estimate adjusted for covariates, panel effects, and time effects.
```

*Table A3 Social Contribution*