Partial Retirement and Labor Supply: Quasi-experimental Evidence from Sweden

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Abstract

The declining share of the working-age population (20-64) has led many countries to introduce social security reforms to extend the working lives of older employees. While reforms such as raising the early retirement age can effectively achieve this goal, they are often perceived as forced. Partial retirement schemes, which allow individuals to work part-time while receiving a significant portion of their previous wages, offer a more flexible alternative. However, the impact of these schemes on overall labor supply remains ambiguous. On one hand, partial retirement may increase labor supply by encouraging part-time work over early retirement; on the other, it may reduce labor supply if full-time workers choose to shift to part-time work. This paper investigates these effects by studying the introduction of a partial retirement scheme for central government employees aged 61-65 in Sweden. The findings show a 6.5% drop in average earnings, suggesting that generous partial retirement terms, which replace a substantial share of prior income, incentivize a shift from full-time to part-time work, thereby reducing the overall labor supply.

JEL classification: J26, J22, J38, H55, J21, C31

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1 Introduction

Demographic changes are challenging social security systems around the world, as fewer young workers are available to support the growing number of older retired people (Attanasio et al., 2007; European Commission, 2021; OECD, 2023). Hence, it is important to increase the labor supply among older employees to alleviate the financial burden on social security systems. To this end, many countries, including Sweden, have introduced social security reforms designed to enhance labor supply. These reforms encompass various strategies, such as changing financial incentives for retirement (Hernæs et al., 2016; Liebman et al., 2009; Manoli & Weber, 2016), enhancing employers' motivations to retain older workers (Behaghel et al., 2008), relaxing mandatory retirement policies (Rabaté, 2019; Shannon & Grierson, 2004), raising the normal retirement age (Behaghel et al., 2008; Hanel & Riphahn, 2012; Lalive & Staubli, 2015), increasing the early retirement age (Cribb et al., 2016; Geyer et al., 2020; Staubli & Zweimüller, 2013), or a combination of these measures (Engels et al., 2017; García-Miralles & Leganza, 2024; Lalive et al., 2023). While the importance of these reforms in increasing labor supply and enforcing later retirement is generally acknowledged in the literature (Gruber & Wise, 1999, 2002, 2009), many employees may not want or find it difficult to work until retirement age (Charles & Decicca, 2007; Gielen, 2009). Simultaneously, employers face challenges in adapting their workforce strategies and retaining older workers under these conditions. Hence, these reforms might be perceived as forced and inflexible by employees and employers, imposing uniform and often binding constraints on individuals who differ in terms of preferences, health, and job opportunities.

Therefore, several OECD countries have introduced partial retirement,[1] a social security reform that provides employees with the flexibility to work part-time while still receiving a significant share of their previous wage (Börsch-Supan et al., 2018; Eurofound, 2016; Kantarci & Van Soest, 2008). This flexibility offers several advantages for employees and employers, including a smoother transition into retirement for employees (Ameriks et al., 2020; Gielen, 2009), better work-life balance (Reday-Mulvey, 2023), the ability for employers to retain experienced staff in a reduced capacity (Ghent et al., 2001; Hutchens, 2010), facilitating the transfer of skills to younger employees (Kantarcı et al., 2023; Reday-Mulvey, 2023), and reducing the costs involved with employees exiting alternative exit routes such as disability insurance (Hernæs et al., 2015; Reday-Mulvey & Delsen, 1996).

However, while partial retirement has various advantages compared to other social security reforms, the effect of partial retirement on labor supply is ambiguous and contingent upon individual preferences of employees and employers. Partial retirement can affect both intensive margin (earnings per worker) and extensive margin (employment rate) of labor supply. *From an employee's perspective*, partial retirement can increase

1. Various terms are used to refer to retirement options that allow individuals to reduce their working hours gradually, such as partial retirement, gradual retirement, phased retirement, and part-time retirement. In this paper, the term "partial retirement" is used because it closely corresponds to the Swedish term, *delpension*, which is the focus of the scheme being studied (Kantarci & Van Soest, 2008).

earnings (intensive margin) by allowing employees to work part-time instead of retiring early (Ameriks et al., 2020; Rutten et al., 2022; Wadensjo, 2006). Conversely, it could decrease earnings if employees opt for part-time work over full-time employment (Elsayed et al., 2018). In addition, partial retirement could increase employment (extensive margin) by keeping employees in the workforce longer (Berg et al., 2020); however, it may decrease employment if, due to part-time working, employees lose their attachment to the labor market and consequently, retire earlier (Albanese et al., 2020; Graf et al., 2011).

From an employer's standpoint, partial retirement can increase earnings if employers grant partial retirement to employees who have initially planned to reduce their working hours to a larger extent or have planned on taking extended sick leave. In contrast, it decreases earnings if employers use partial retirement as a strategy to lower their wage costs (Albanese et al., 2020; Graf et al., 2011). Moreover, the introduction of partial retirement may increase employment if employers use partial retirement to retain older, experienced workers who might otherwise have left the workforce entirely (Hutchens, 2010; Oude Mulders & Henkens, 2019). However, it decreases employment if employers leverage partial retirement to negotiate with less productive older employees to retire early (Albanese et al., 2020; Graf et al., 2011). Thus, the overall effect of partial retirement on labor supply is unclear.

It is empirically challenging to evaluate the pure effect of partial retirement on labor supply. In most countries, the partial retirement eligibility age is below the eligibility age for early retirement. Therefore, partial retirement may be considered a substitute for inaccessible or costly (early) full retirement.[2] As a result, existing studies focus on the labor supply effects of partial retirement schemes on individuals who are still not eligible for early retirement. While these studies offer valuable insights into the effect of part-time working on labor supply; however, it is conceivable that the substitution effect from early retirement confounds the pure impact of enabling individuals to work part-time.

This paper studies the effect of partial retirement on labor supply in Sweden, which has important advantages. First, Sweden's partial retirement scheme for central government employees enables employees to work part-time from the age of 61,[3] which is also the early retirement age, until they reach the normal retirement age of 65.[4] Therefore, the institutional setting provides an opportunity to isolate the effect of allowing individuals to work part-time on labor supply, as employees have access to both early and partial retirement options simultaneously. Second, the scheme is part of the occupational pension[5] reform that was swiftly

2. For employees ineligible for statutory early retirement options, alternative avenues to finance their retirement may include exploring options such as unemployment insurance, disability insurance, sickness insurance, occupational pensions, or other early retirement programs (Palme & Svensson, 2004).
3. As of 2020, the early retirement age has been raised to 63, and the normal retirement age has been increased to 66 as of 2023.
4. As of 2023, following the rise in the normal retirement age to 66, eligibility for partial retirement has also been extended to 66 for specific individuals. If an employee, who was born in 1958 has been receiving a partial pension and is entitled to the minimum guaranteed pension, then the employer has the option to extend their partial retirement until age 66.
5. The occupational pension complements the public pension; it is funded by the employer and covers approximately 20% of

implemented in 2003, allowing to control for time-variant confounding factors that may bias the results (Arbetsgivarverket, 2008). Third, Sweden has a notably high employment rate among older individuals,[6] thus making partial retirement relevant to a significant segment of the workforce and is highly policy-relevant. Finally, the uniquely rich labor data, with comprehensive administrative earnings records covering Sweden's entire population, enables a precise analysis of the scheme's causal impact. The data allows for capturing effects not only on the extensive margin but also on the intensive margin.

Using the difference-in-difference-in-differences (DiDiD) methodology, I estimated the effect of the introduction of the partial retirement scheme on the labor supply of 61-65-year-old employees in the central government sector in Sweden. This analysis compares labor supply outcomes for central government employees aged 61-65, who are eligible for the scheme, with municipality employees and younger employees aged 56-60, who are ineligible. The DiDiD approach uses data from before and after 2003, the scheme's implementation year, to control for time-driven confounding factors by comparing labor supply outcomes across sectors. In addition, including different age groups as an additional control layer in the DiDiD specification addresses sector-specific biases that could influence the comparisons between the sectors.

The analysis is organized into three key sections: one main analysis and two additional analyses. In the main analysis, I estimate the effects of the partial retirement scheme on two labor supply outcomes—earnings per capita and employment rate. The first additional analysis examines how the partial retirement scheme interacts with existing social insurance programs, specifically sickness insurance (SI) and disability insurance (DI). The second additional analysis extends the study to evaluate the scheme's impact on employees aged 66-69, after the partial retirement eligibility age has passed.

In the main analysis, first, I examine the overall per capita effects, showing that the introduction of the partial retirement scheme results in a 6.5% reduction in average earnings per capita among central government employees aged 61-65. Next, I decompose this total effect on earnings per capita into two components: the intensive margin (earnings per worker) and the extensive margin (employment rate). The findings indicate that approximately 60% of the total effect is driven by the intensive margin, reflecting reduced working hours due to part-time work, while the remaining 40% is due to a reduction in the extensive margin, indicating a decrease in the employment rate following part-time work.

Finally, I discuss the supply- and demand-side factors influencing the reductions in both the intensive and extensive margins. On the intensive margin (earnings per worker), partial retirement provides financial incentives for employees to shift from full-time to part-time work. Employees see a smaller reduction in their

the total gross pension (Hagen et al., 2022).

6. Sweden's employment rate for individuals aged 61–65 is the highest among the 28 European countries, and Israel included in the SHARE dataset (see Figure A.1).

earnings compared to the reduction in their working hours, and the impact on their pension benefits is minimal, therefore making part-time work an appealing option compared to full-time work. From the employer's perspective, allowing employees to move from full-time work to part-time work reduces wage expenses, as fewer hours need to be paid for without necessarily hiring additional staff.

On the extensive margin (employment rate), the shift from full-time to part-time work leads to a gradual decline in labor market attachment. Employees who transition to part-time work are more likely to eventually retire fully, which reduces the overall employment rate. For employers, partial retirement serves as an effective cost-cutting strategy. By offering partial pensions, employers implicitly or explicitly signal to employees that full retirement is expected soon after reducing their hours, thus lowering wage expenses and resizing their workforce.

The first additional analysis investigates how the partial retirement scheme interacts with sickness insurance (SI) and disability insurance (DI). The findings show that the scheme's introduction has led to a 6.4% reduction in transitions from employment to SI or DI. This reduction likely occurs because individuals view the terms of partial retirement as more favorable than those of SI or DI, leading them to choose partial retirement over these programs. As a result, this shift eases the financial burden on government resources dedicated to SI and DI funding.

The second additional analysis extends the study to include individuals aged 56-70, exploring the longer-term effects of partial retirement beyond the eligibility age of 64. The results show no statistically significant impact on the labor supply of individuals over 65, indicating that part-time work under the scheme does not have a lasting effect on the labor supply.

This study makes at least three major contributions to the literature. First, it builds upon the broad literature on social security reforms aimed at enhancing labor supply (e.g., Cribb et al., 2016; Engels et al., 2017; Hernæs et al., 2016; Lalive et al., 2023; Liebman et al., 2009). This research extends these studies by determining the causal labor supply effects of a social security reform—partial retirement—that provides employees with work flexibility, offering deeper insights into how such schemes shape employee work patterns.

Second, it talks to the literature on understanding interactions in public policies across programs. Previous studies have found that reforms that reduce the access or generosity of retirement programs lead to increased take-up of alternative exit routes from the labor market (e.g., Bratberg et al., 2004; Duggan et al., 2007; Hernæs et al., 2016; Johnsen et al., 2022; Karlström et al., 2008; Røed & Haugen, 2003; Vestad, 2013). This paper shows that the reverse effect can also occur: a generous reform like partial retirement can reduce the use of other programs, such as sickness insurance (SI) or disability insurance (DI). This finding suggests that

while generous reforms may reduce overall labor supply and increase public costs by supporting part-time work, they can also lessen the financial burden on programs like SI and DI, partially offsetting the total public costs.

Third, this paper closely contributes to the literature on gradual retirement schemes (see Table A.1). For example, Graf et al. (2011) found that participants in Austria's Old-Age Part-Time Scheme (OAPT) stayed employed 30 days longer during the first two years of participation but worked 35 and 50 days less in the fourth and fifth years, respectively. Similarly, Huber et al. (2016) observed that Germany's partial retirement scheme, Altersteilzeit (ATZ), reduced exits to unemployment programs in East Germany. Berg et al. (2020) found that German male participants in ATZ extended their working careers by 1.2–1.8 years using a DiD strategy. In Belgium, Albanese et al. (2020) reported that participation in a gradual retirement scheme increased employment by two years for men and four years for women. Additionally, Rutten et al. (2022) noted that Dutch municipalities with gradual retirement schemes experienced a 2.8-hour increase in monthly working hours.[7]

Existing studies on partial retirement schemes provide mixed evidence regarding their effects on labor supply, with outcomes varying based on factors such as scheme regulations, national labor markets, and pension system structures. This paper adds to this literature by demonstrating that when partial retirement terms are particularly favorable—making part-time work more attractive than full-time employment—the result is a reduction in average working hours.

In addition, this study addresses several empirical challenges in the previous papers. The schemes studied in the literature often impact all individuals (Albanese et al., 2020; Berg et al., 2020; Graf et al., 2011; Wadensjo, 2006) making it difficult to establish a proper control group to evaluate their effects or the implementation of the scheme may be at the firm or municipality level, potentially leading to selection biases in treated firms (Hermansen, 2015; Huber et al., 2016) or municipalities (Kantarcı et al., 2023). This study leverages the quasi-experimental design of a scheme that was implemented rapidly, allowing for a clearer identification of causal effects. By employing a DiDiD approach, this analysis effectively controls for potential selection biases and isolates the scheme's impact on individual labor supply.

Finally, this paper contributes to the literature by offering a clearer assessment of partial retirement's impact on labor supply, made possible by the absence of a "block model" in Sweden's pension system. Unlike in Germany, Austria, and Belgium, where gradual retirement schemes include a block model that allows

7. Additional early cross-country works on partial retirement include Been & van Vliet (2014), Kantarci & Van Soest (2008), Delsen (1996), Reday-Mulvey (2005), Morris & Mallier (2003). Other studies that focus on partial retirement in specific countries include Gielen (2009) in the UK; Machado & Portela (2012) in Portugal; Elsayed et al. (2018), Kantarci & Van Soest (2008), and Bernasconi & Kantarcı (2023) in the Netherlands; Wadensjo (2006), Sunden (1994), and Lachowska et al. (2009) in Sweden; Haan & Tolan (2019) in Germany.

employees to work full-time initially and then fully retire while remaining officially employed, the Swedish scheme requires a continuous reduction in hours. This absence of a block model in Sweden enables an accurate capture of the true effect of partial retirement on labor supply.

The paper is structured as follows: Section 2 provides the institutional background, followed by the data description in Section 3. Descriptive statistics are summarized in Section 4, while the empirical strategy is outlined in Section 5. Section 6 presents the main results, with additional findings discussed in Section 7. Section 8 explores heterogeneity analysis, and Section 9 addresses potential identification threats. The paper concludes in Section 10.

2 Institutional background

2.1 The Swedish pension system

The pension system in Sweden comprises two primary components: state-provided universal public pensions and occupational pensions. While most retired individuals rely primarily on the public pension system for their retirement benefits, occupational pensions play a significant supporting role. Occupational pensions consist of several different pension plans negotiated at the union level and cover a large group of workers. The four largest agreement-based occupational pension plans cover approximately 90% of the total workforce (Pensionsåldersutredningen, 2012). These include the pension plan for blue-collar private sector employees, white-collar private sector employees, municipality employees, and central government employees.

Introduced gradually since 1999, the public pension system has undergone phased implementation. The first cohort to participate in the new system included those born in 1938. This cohort received one-fifth of their pension benefit from the new system and four-fifths from the previous system. Each subsequent cohort thereafter increased their participation in the new system by 5%, resulting in those born in 1954 and onward participating solely in the new system (Sundén, 2006). The analysis sample in this paper consists of workers between 61 and 65 years old belonging to the 1934-1947 cohorts who are currently in the transitional phase of receiving a weighted average of benefits from both systems.

Under the current public pension system, the pension amount is calculated based on the individual's entire lifetime income, unlike in the previous pension system, where the 15 best years of one's income were the basis for a large part of one's pension. Pension benefits can be withdrawn at the earliest age of 61[8] and there is no upper age limit for when a pension must be paid. The pension amount increases the longer the individual delays his or her withdrawal. However, the previous pension system fixed the retirement age at

8. In 2020, Sweden raised the early retirement age from 61 to 62. Additionally, there is an official plan to further increase it to 63 in 2023 and then to 64 in 2026 (OECD, 2021).

65. Early withdrawals starting at age 61 years, with a 0.5% reduction in annual pension for each month of early withdrawal, were possible. Deferred withdrawals were allowed with an increase of 0.5-0.7% in annual pension for each month after the age of 65.

Agreement-based occupational pensions are constructed and thought of as supplements to the public pension system, as they provide pension benefits above the income ceiling[9] in the public pension system. As a result, occupational pensions play a more significant role in the gross pension of individuals earning above the ceiling than those earning below it. The amount of occupational pension received varies based on the employee's sector, cohort, and income history. For example, for a median income earner at the age of 65, the occupational pension typically constitutes 20% of the total gross pension (Hagen et al., 2022).

The occupational pension for central government employees was calculated using the PA91 plan; however, in 2003, PA91 was replaced by PA03.[10] These plans have two components, namely, a PAYGO defined benefit component based on a percentage of the employee's earnings over the last five years, and a defined contribution component based on the employee's earnings history. Compared with PA-91, PA-03 places more emphasis on the defined contribution portion. For employees born before 1942, their occupational pension is determined using the PA91 scheme. On the other hand, for those born between 1942 and 1972, their occupational pension is calculated by a weighted average of the pensions from both the PA91 and PA03 systems. The shift from PA-91 to PA-03 was implemented gradually over 30 years, ensuring a smooth transition that did not abruptly impact employees' final pension amounts.

2.2 Partial retirement in the central government

The partial retirement scheme is regulated by an agreement between the Swedish Employers Agency and central employee organizations[11] in the state agreement area.[12] The Swedish Employers Agency (also known as "Arbetsgivarverket" in Swedish) is a government agency in Sweden that is responsible for providing support and advice to central government agencies and institutions on matters relating to employer responsibilities. This includes areas such as collective bargaining, wages, benefits administration, and human resources management.

9. The public pension system contains a ceiling on the income qualifying for pension rights. The ceiling is currently at 7,5 income base amounts. For 2022, this means that no pension rights are earned for the monthly wage portion that exceeds SEK 48 000

10. Central government employees were covered by the SPR occupational pension scheme before 1991. This was later replaced by PA-91 and then PA 03 in 2003. The PA16 plan, which was introduced in 2016, applies to those born after 1966. The individuals in the analysis are older and still have PA91 or a weighted average of PA91 and PA03 for their occupational pensions.

11. The central employee organizations include the Swedish Confederation of Professional Associations (Saco), the Swedish Trade Union Confederation (LO), and the Swedish Confederation of Professional Employees (TCO), among others.

12. In Sweden, the "state agreement area" (statligt avtalsområde) refers to the area covered by collective bargaining agreements between the Swedish government and public sector employees. This group includes employees in various government agencies, such as the Swedish Tax Agency, the Swedish Social Insurance Agency, and the Swedish Public Employment Service, as well as employees in public hospitals and other healthcare facilities.

Since 2003, central government employees aged 61 to 64 have had the opportunity to apply for partial retirement. This allows them to work part-time until they turn 65 while retaining a significant portion of their previous wage. The partial pension constitutes 60% of their lost wage due to part-time work and is financed by the employer according to special rules. For example, if an employee reduces his or her working hours by 20%, the employer compensates for 60% of the lost wage, which is equivalent to 12% of his or her initial wage (i.e., 60% × 20% = 12%). As a result, an employee can receive 92% of his or her wage while working 80% (i.e., 80% + 12% = 92%). Table 1 lists the replacement rates for the different working hours. All employees who have worked for at least five years in the central government can apply for partial retirement. However, the final decision is reached through negotiation with the employer (Arbetsgivarverket, 2003a,b).

Table 1: Partial Retirement Compensation Rates Based on Employee Work Percentage.

Percentage of full-time work based on 100% employment X%	Percentage of total wage (before tax[13]) $(100\% - X\%) \times 0.60 + X\%$
50%	80%
60%	84%
70%	88%
80%	92%
90%	96%

The partial pension benefit is equal to 60% of the lost income due to reduced working hours and is funded by the employer, according to special rules. The percentage of the total wage granted in partial retirement is calculated based on the percentage of full-time work, using the formula $(100\% - X\%) \times 0.60 + X\%$, where $X\%$ is the percentage of full-time work. The wage used for this calculation is the employee's total wage before tax.

Table 2 displays a gradual increase in the number of newly granted partial pensions since the implementation of the scheme in 2003, which reached its peak in 2007. In the first year after the scheme's introduction, 1,942 employees (9% of the total eligible central government employees) were granted partial pensions, followed by a decline to 877 in 2004. The number of granted partial pensions decreased in 2004 since most eligible applicants had already received partial pensions in the scheme's first year. In addition, partial pensions can be granted at various scopes, representing different percentages of reduction in average working hours. Table 2 shows that at the beginning of the scheme, employers were more generous by granting a significant number of partial pensions at a 50% reduction rate. However, in subsequent years, there was a reduction in the number of 50% partial pensions granted, accompanied by an increase in the number of partial pensions set at 20%.

Table 2 shows an increase in the number of granted partial pensions post-2003. However, interpreting the increase in the intensity of partial pension take-up is not straightforward for two reasons. First, the scope of granted partial pensions has undergone changes over time. Second, there is the possibility that the overall number of central government employees has increased, potentially contributing to the increase in the

13. If the tax effect is included, then the difference between wages with and without partial pensions is even smaller.

number of granted partial pensions. To better understand the extent of the reduction in average working hours each year, Figure 1 provides a graphical representation of the average scope of granted partial pension divided by all 61- to 65-year-old central government employees each year. The figure shows that while the average scope of granted partial pension was approximately 3.5% per central government employee in 2003, it increased to approximately 6% by 2008.

Table 2: Distribution of Newly Granted Partial Pension by Scope Among Central Government Employees (2003-2010)

	2003	2004	2005	2006	2007	2008	2009	2010	Total
1%-19%	21	9	14	24	28	31	32	31	190
20%-29%	651	388	713	906	1,211	1,145	1,196	1,238	7,448
30%-39%	72	18	53	50	44	38	42	33	350
40%-49%	202	73	93	125	150	105	77	100	925
50%	996	389	485	474	514	413	317	271	3,859
Total newly granted (share %)	1,942 (9%)	877 (14%)	1,358 (13%)	1,579 (12%)	1,947 (13%)	1,732 (12%)	1,664 (11%)	1,673 (10%)	12,772
Total granted (share %)	1,942 (9%)	2,742 (11%)	3,724 (14%)	4,585 (15%)	5,707 (17%)	6,522 (19%)	6,231 (18%)	6,046 (18%)	

Note: This table categorizes the number of newly granted partial retirements among central government employees aged 61-65 from 2003 to 2010. The percentages in parentheses represent the share of new and total partial pension recipients in the central government sector for each year.

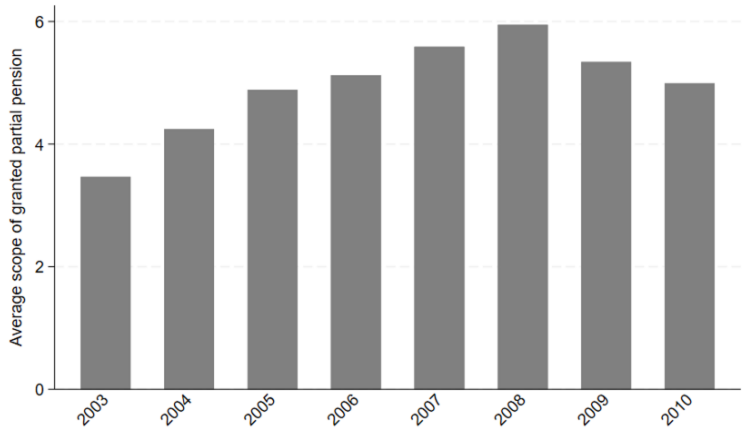


Figure 1: Average Scope of Granted Partial Retirement Per Central Government Employee

Note: This figure illustrates the average scope of granted partial retirement per central government employee aged 61-65 from 2003 to 2010. The percentages are calculated by multiplying the number of granted partial pensions by their corresponding percentage reductions (see Table 2), then dividing by the total number of central government employees aged 61-65 each year.

2.3 Objectives and financial incentives for employers and employees

The primary goal of the partial retirement scheme is to enable employers to extend opportunities for older employees, with the support of the scheme, to work until the age of 65 instead of retiring early (Arbetsgivarverket, 2003a,b). Employers may find it important to retain older employees for longer periods of time.

They might face difficulties in recruiting young employees while a large number of experienced employees are approaching retirement age. Additionally, employers may see partial retirement as a way to prevent extended sick leaves and ensure a continuous supply of valuable skills. Furthermore, employers may want to keep employees with irreplaceable skills who are unable to work full-time for various reasons, even if there is no illness. The partial retirement scheme can enable these employees to continue contributing to the workforce on a part-time basis and facilitate the transfer of skills to younger employees (Kantarci & Van Soest, 2008). On the other hand, partial retirement can be a practical way to gradually reduce surplus skills within the workforce, avoiding the need for formal redundancy procedures outlined in security agreements (Arbetsgivarverket, 2003b). It offers an effective solution for managing workforce adjustments and maintaining the overall competence needed for the organization.

The financial benefits of partial retirement are favorable for employees as it allows them to receive a considerable portion of their wages despite working reduced hours. When factoring in income taxes, the difference in earnings becomes even smaller. The decision to receive partial pension may lead to a reduction in an employee's public pension as partial pension is not considered pensionable income.[14] Therefore, employees who opt for this option may miss out on the opportunity to accumulate pension rights from the public pension system that they could have retained had they continued working full-time. However, the impact on the public pension of high-income earners whose income remains above the income ceiling even after reducing their working hours is not significant. For low-income earners, calculations by Hallberg (2008) show that the reduction in the replacement rate[15]is only approximately 1-2%. Furthermore, opting for partial retirement does not affect the occupational pension.

Several factors affect employers' financial positions. A decisive factor for the employer's cost is whether the working hours lost when a person is granted a partial pension are replaced with a new job or not. Riksrevisionen (2008) interviewed several representatives of employers and trade union employee organizations in 2007 and found that partial pensions in several cases were used in connection with business changes or reductions. New hires to replace lost working hours due to partial retirement were usually not considered. In addition, the employer's costs are reduced if employees work part-time without a proportional reduction in their workload. Riksrevisionen (2008) indicates that many partial pension recipients believe that they have the same tasks as before or that their workload has not decreased in line with their working hours. Several trade union representatives have raised problems with those who are granted partial pensions not being released from their work duties to the same extent as their working hours are reduced.

14. Pensionable income in the Swedish public pension system includes wages as well as payments from social security and unemployment insurance systems (Hagen et al., 2022).
15. The replacement rate is an indicator of the extent to which a pension scheme is generous, as it is calculated by dividing the (average) pension an individual (or a given population) receives in a given time period by their (average) income during the same period (Hagen et al., 2022).

3 Data

This study exploits two administrative data sources that are matched using individual identifiers. First, the *Longitudinal Integration Database for Health Insurance and Labor Market Studies (LISA)* provides demographic and socioeconomic data for the entire Swedish population which is provided by Statistics Sweden. Second, the *State Occupational Pensions Agency (SPV)* provides partial retirement statistics. The SPV administers occupational pensions for central government employees, former employees, and pensioners.

The data provided by the SPV include administrative data on partial pensions, namely, the scope, the percentage of reduction in the working hours of granted partial pensions, and the start and end years of pension reception. Within this dataset, it is possible to distinguish employees who received a partial pension from those who were either rejected or did not apply for a partial retirement. Employees apply for partial pensions following discussions with their employers. Consequently, most partial retirement applications are approved, and data on rejected applications are not available in the dataset.

Three restrictions are applied to the data. First, to ensure an appropriate treatment group (central government employees) and control group (municipality employees), individuals are associated with their respective sectors based on their employment at age 60. Only employees in the central government and municipality sectors between 1998 and 2008, from age 56 to 65, [16] are retained. This restriction assumes that individuals were employed at the age of 60, resulting in a sample size of 454,465 employees. Second, employees with exceptionally high incomes (exceeding SEK 800,000 per year, adjusted for prices in 2010) are excluded. After applying this restriction, the analysis sample comprises 451,613 employees.

Third, individuals in occupations who were exposed to an occupational pension reform in 2000 in the municipality sector are excluded. This reform raised the retirement age from 63 to 65 for individuals born in 1938 or later, specifically affecting occupations such as personal care, nursing, and restaurant services (Hagen, 2018). Excluding these employees helps prevent any confounding effects from this reform on labor supply. The final sample includes 284,173 individuals—95,551 in central government and 188,622 in the municipality sector.

To evaluate the labor supply effects of the partial pension scheme, two outcome variables are examined: average earnings per capita, including non-workers as contributing zero earnings, and the employment rate. Since individual working hours are not reported in the data, per capita earnings serve as a proxy for annual work hours. Although this measure does not directly capture working hours, it reasonably reflects earnings variations due to reductions in work hours. Individuals who retire remain in the sample for subsequent years,

16. Employees between the ages of 61 and 64 are eligible to receive partial pensions. However, since data is recorded based on the age of individuals at the end of each year, there is a discrepancy for those who turn 65 mid-year. These individuals are documented as being 65 years old for the entire year, even though they received partial pensions during the months when they were actually 64. For this reason, the sample covers 61-65-year-old sold employees instead of 61-64-year-old employees.

meaning that per capita earnings reflect both extensive (retirement) and intensive (reduced working hours) margin adjustments. The employment rate is calculated by defining an employment indicator that equals 1 if an individual earns more than one "price base amount" in 2010 (SEK 42,400).[17]

4 Descriptive statistics

4.1 Partial pension recipients versus nonrecipients

In this section, I focus solely on central government employees and examine the differences in labor supply outcomes and characteristics between partial pension recipients and nonrecipients. This comparison helps to understand the differences between recipients' and nonrecipients' labor supply decisions and form reasonable expectations regarding the potential effects of the scheme.

Table 3 provides an overview of the characteristics of the partial pension recipients compared to nonrecipients among central government employees at age 60, which is one year before they become eligible to apply for partial retirement. The table includes earnings per capita, net financial wealth, receiving sickness insurance, demographics, occupation, and industry.

The average earnings per capita of partial pension recipients at the age of 60 is SEK 11,665 (or 3.8%) [18] higher than that of nonrecipients. This finding suggests that partial pension recipients are in a better financial situation than nonrecipients. The data also reveal that the financial wealth of partial pension recipients is SEK 156,687 (or 12%) higher than nonrecipients, confirming that they are in a more favorable financial position. In addition, partial pension recipients are 2 percentage points less likely to receive sickness insurance at age 60. This result could suggest that partial pension recipients are more stable workers who are less likely to experience a prolonged period of illness that would require them to claim sickness insurance.

Despite the equal gender distribution in the central government workforce, women are 6 percentage points more likely to receive partial pensions than men. This trend aligns with broader patterns observed in Sweden and Europe, where women are more likely to work part-time (Eurofound, 2016; Reday-Mulvey, 2005). The higher propensity of women to engage in part-time work reflects their prioritization of family responsibilities (Duncan et al., 2003; Hakim, 2002), addressing health-related challenges (Lanninger & Sundström, 2013), or providing care for elderly family members (Ulmanen & Szebehely, 2015).

17. The "price base amount" (Prisbasbelopp) is an index used to calculate social security benefits, pensions, and taxes in Sweden, adjusted annually to reflect changes in the Consumer Price Index (CPI).
18. adjusted for 2010

Partial pension recipients are 7 percentage points more likely to be married. This difference may be attributed to the fact that married employees typically have greater caregiving responsibilities for elderly family members (Lüthje et al., 2014) or that they may prioritize spending leisure time with their partners, which could lead to a greater tendency to receive partial pensions and reduce their work hours.

Partial pension recipients are 7 percentage points more likely to be highly educated, defined as having completed at least a 3-year university degree. This trend may stem from the greater financial capacity of highly educated employees to afford part-time work (Beehr & Bennett, 2015). Additionally, the nature of their occupations, which are often less physically demanding, may provide more opportunities for part-time arrangements. Highly educated employees are also more likely to hold positions that grant greater autonomy over their work schedules, enabling them to negotiate part-time work arrangements more effectively (Van Solinge & Henkens, 2005).

The main jobs in the central government sector include roles in public administration and defense, education, real estate, and business activities, with employees working as administrators, police officers, and university teachers. The distribution of recipients and nonrecipients across occupations and industries mirrors the overall population in the central government, suggesting no selection bias in receiving partial pension based on occupation or industry.

The data shown in Table 3 demonstrates that while partial pension recipients and nonrecipients are similar or only marginally different in terms of family status, occupation, and industries, they are more likely to be in a better financial situation, female, married, and highly educated.

4.2 Treatment versus control group

Table 4 presents descriptive statistics for labor supply measures—earnings and employment—comparing the treatment group (central government employees) with the control group (municipality employees). Panel (a) displays data for individuals aged 61-65 years, showing how the treatment and control groups differ before and after 2003, following the introduction of the partial retirement scheme. Panel (b) focuses on individuals aged 56-60 years, who were not impacted by the scheme. The Diff-in-Diff column reflects the differences between treatment and control groups before and after 2003. The final panel presents the Diff-in-Diff-in-Diff, which shows the difference between the two difference-in-differences columns from the two previous panels, comparing the older (61-65 years) and younger (56-60 years) age groups.

The first row of Table 4 reveals that prior to 2003, central government employees had SEK 46,466 greater earnings than municipality employees. However, after 2003, this gap narrowed to SEK 40,536. Consequently,

Table 3: Descriptive Statistics of Partial Pension Recipients and Nonrecipients

	Participants	Non-participants	Diff	P-value
Earnings per capita (SEK)	305,170	293,505	11,665	<.001
Net financial wealth (SEK)	1,415,528	1,258,840	156,687	<.001
Receiving sickness insurance	0.14	0.16	-0.02	<.001
Males	.49	.55	-.06	<.001
Single	.10	.13	-.03	<.001
Married	.70	.63	.07	<.001
Divorced	.04	.03	0	.3
Widowed	.17	.20	-.04	<.001
Highly educated	0.71	0.64	0.07	<.001
Occupation (education level required from 1 to 10) (Share %):				
Occupations required high university competence (2)	4,380 (28%)	11,063 (72%)	-6,683	
Occupations with university competence (3)	3,665 (30%)	8,451 (70%)	-4,786	
Administrators & customer service (4)	812 (20%)	3,254 (80%)	-2,442	
Managerial positions (1)	288 (18%)	1,327 (82%)	-1,039	
Occupations required shorter training (9)	117 (8%)	1,386 (92%)	-1,269	
Service, care, sales work (5)	138 (17%)	693 (83%)	-555	
Construction & manufacturing (7)	123 (10%)	1,122 (90%)	-999	
Military (10)	0 (0%)	283 (100%)	-283	
Agriculture and gardening (6)	8 (4%)	171 (96%)	-163	
Manufacturing (8)	29 (5%)	603 (95%)	-574	
Industry (Share %):				
Public administration and defense	6,228 (28%)	16,090 (72%)	-9,862	
Education	1,580 (25%)	4,863 (75%)	-3,283	
Real estate and business activity	1,253 (28%)	3,153 (72%)	-1,900	
Transportation, storage and communication	79 (5%)	1,509 (95%)	-1,430	
Health and social work	65 (8%)	701 (92%)	-636	
Other community & social service activities	149 (13%)	1,021 (87%)	-872	
Other industries	106 (13%)	734 (87%)	-628	
Number of observations	9,560 (25%)	28,353 (75%)		

The table presents a sample of central government employees who are 60 years old (1 year before being eligible to receive partial pension) from 2003 to 2008. The first column displays the characteristics of part-time pension recipients, and the second column considers central government workers who did not receive a partial pension. The "Diff" column presents the differences between the two groups. The last column indicates the p-value of the differences between recipients and nonrecipients.

the difference-in-differences suggests a SEK 5,930 (2.2%) reduction in the average annual earnings, indicating that the scheme had a negative impact on earnings. The second row shows a 1.9 percentage point reduction in the employment rate gap between the treatment and control groups after 2003, indicating a decline in the employment rate following the scheme's implementation. In Panel (b), the earnings difference between the treatment and control groups does not change significantly after 2003, and the employment rate difference between the two groups drops by only 0.2 percentage points. This result suggests that the scheme did not influence labor supply among younger individuals, who were not affected by it.

To isolate the effect of the scheme from potential sector-specific trends, the final panel compares the difference-in-differences of earnings and employment rates for older and younger groups. It shows that the average earnings and employment rate for central government employees aged 61-65 decreased by SEK 5,678 and 1.7 percentage points compared to municipality employees aged 56-60, supporting the view that the scheme negatively impacted older workers. While these results offer initial evidence of the scheme's impact, it is crucial to note that these estimates do not control for key variables such as year, age, and

industry classifications, which could provide a more refined understanding of the scheme's effect.

Furthermore, Tables A.3 and A.4 compare the treatment and control groups based on various socioeconomic characteristics for individuals aged 61-65 and 56-60, respectively. The treatment and control groups are similar in terms of education (years of schooling), number of children at home, and marital status. The treatment group, comprising central government employees, primarily includes individuals working in public administration, defense, and education, often as administrators, university professors, and specialists. The control group consists of municipality employees, predominantly employed in education and health and social work sectors, such as care providers, schoolteachers, and administrators.[19]

Despite differences in the types of occupations across the two sectors, Table A.3 shows that the differences between the treatment and control groups remain relatively stable after the introduction of the scheme in 2003. This stability suggests that variations in labor supply measures between the groups are unlikely to be driven by structural changes in socioeconomic characteristics. To further account for the potential influence of these variables on labor supply outcomes, I include the characteristics reported in Table A.3, along with age fixed effects, in the main regression analysis.

5 Empirical strategy

5.1 Visual evidence

Figure 2 provides graphical insight into the impact of the partial retirement scheme on earnings per capita by comparing the trends for 61-65-year-olds in the treatment (central government employees) and control (municipality employees) groups from 1998 to 2008. The vertical line indicates the scheme's introduction. Panels (a) and (b) illustrate the earnings progression for 61-65-year-olds, with (a) presenting the raw earnings data and (b) indexing earnings to 2002 levels. Panels (c) and (d) display the corresponding earnings trends for 56-60-year-olds, a group unaffected by the scheme.

Panels (a) and (b) demonstrate that before the scheme, earnings increased similarly in both the treatment and control groups, supporting the parallel trends assumption for the DiD analysis. After 2003, earnings growth slowed in the treatment group compared to the control, suggesting a potential labor supply effect of the scheme.

While Figure 2.(a) and 2.(b) suggest parallel trends before 2003; one potential concern is that sector-specific trends, rather than the scheme, might explain the post-2003 divergence in earnings. To address this issue, I

19. Municipality employees working in personal care, nursing, and restaurant services were excluded from the primary sample.

Table 4: Descriptive Statistics of Labor Supply Measures for the Treatment and Control Groups

(a) 61-65 years old							
	1998-2002			2003-2008			
	Treatment	Control	Diff	Treatment	Control	Diff	Diff-in-Diff
Earnings per capita (SEK)	270,690	224,223	46,466***	352,685	312,148	40,536***	-5,930***
	(250,341)	(194,343)	[<.001]	(259,339)	(207,196)	[<.001]	[<.001]
Employment rate	0.802	0.793	0.009***	0.872	0.882	-0.010***	-0.019***
	(0.398)	(0.405)	[<.001]	(0.334)	(0.323)	[<.001]	[<.001]
N	82,840	176,014	258,854	160,525	307,697	468,222	727,076
(b) 56-60 years old							
	1998-2002			2003-2008			
	Treatment	Control	Diff	Treatment	Control	Diff	Diff-in-Diff
Earnings per capita (SEK)	444,861	374,156	70,705***	481,850	411,397	70,453***	-251
	(193,856)	(149,808)	[<.001]	(200,133)	(158,878)	[<.001]	[0.739]
Employment rate	0.990	0.989	0.006***	0.996	0.992	0.004***	-0.002***
	(0.072)	(0.100)	[<.001]	(0.064)	(0.090)	[<.001]	[<.001]
N	130,612	251,112	381,724	191,284	368,470	258,854	941,478

	Diff-in-Diff-in-Diff
Earnings per capita (SEK)	-5,678***
	[<.001]
Employment rate	-0.017***
	[<.001]
N	1,668,554

Notes: This table presents descriptive statistics for earnings per capita and employment rate across treatment and control groups for individuals aged 56-60 and 61-65, before and after the introduction of the partial retirement scheme in 2003 Sweden. The Diff columns show the differences between treatment and control groups within each time period (1998-2002 and 2003-2008). The Diff-in-Diff column represents the difference-in-differences (DiD), capturing the impact of the pension reform by comparing the changes over time between treatment and control groups. The Diff-in-Diff-in-Diff column at the bottom of the table provides the differences across age groups, comparing the older (61-65 years) and younger (56-60 years) groups. Earnings are reported in SEK (Swedish Krona). The employment variable equals 1 if the individual's annual earnings exceed 1 price base amount in 2010 (SEK 42,400). Standard deviations are reported in parentheses and p-values in brackets. Statistical significance is denoted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

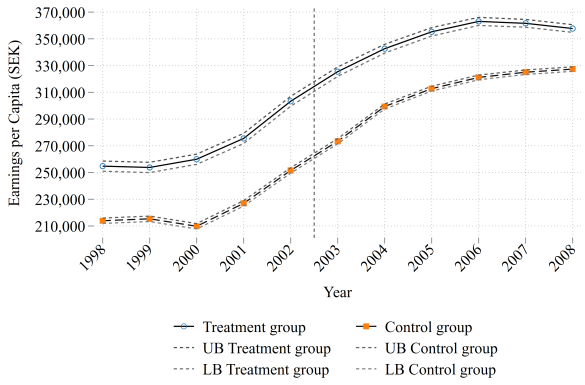
compare earnings trends between treatment and control groups for younger individuals aged 56-60, who were not eligible for partial retirement. As shown in Panels (c) and (d), the earnings paths for younger employees in both groups are parallel, supporting the assumption that sector-specific trends are unlikely to explain the differences observed in the older group post-2003.

5.2 Regression estimates

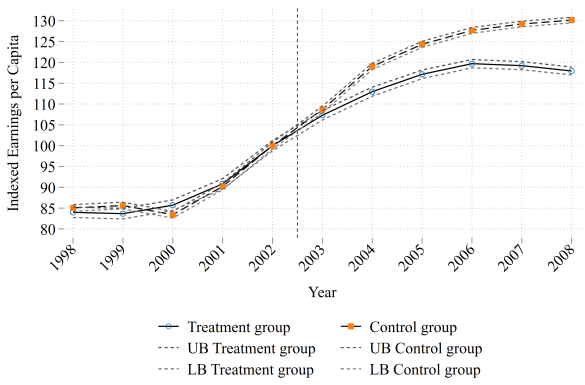
I begin by estimating the difference-in-differences (DiD) model, where the dependent variable is the labor supply outcome for individual i in year t, between the ages of 61 and 65:

$$y_{i,t} = \alpha + \beta(Sector_i \times Post_t) + \phi Post_t + \gamma TYG_i + X_{i,t}\sigma + \lambda g_{i,t} + u_{i,t} \tag{1}$$

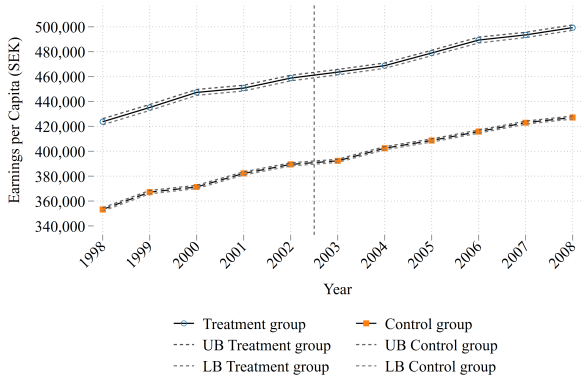
In this equation, $y_{i,t}$ represents labor supply outcomes. The variable $Sector_i$ is a binary indicator equal to 1 if individual i works in the treatment group (central government employees) and 0 if they work in the control group (municipality employees). $Post_t$ is a binary variable equal to 1 for years after 2002, when the



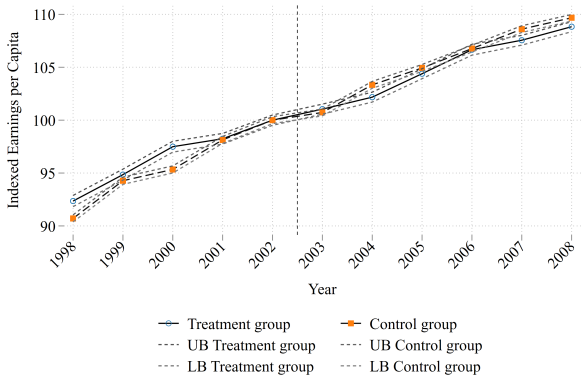
(a) 61-65 years old



(b) 61-65 years old, indexed to 2002=100



(c) 56-60 years old



(d) 56-60 years old, indexed to 2002=100

Figure 2: Average Earnings per Capita of Central Government and Municipality Employees by Year and Age Group

Notes: Panel (a) shows the average earnings per capita for individuals aged 61-65, while Panel (b) displays the same data indexed to 2002 = 100. Panels (c) and (d) show corresponding trends for the 56-60 age group. The x-axis spans from 1998 to 2008. Upper and lower bounds represent the 95% confidence interval.

partial retirement scheme was introduced, and 0 for prior years. $X_{i,t}$ includes control variables as listed in Table A.3, and $g_{i,t}$ controls for age fixed effects. The coefficient β captures the scheme's impact on the labor supply of individuals aged 61-65 after 2002.

To explore the dynamics of the scheme's effects over time, I extend Equation 1 to estimate labor supply effects for each year individually. This allows for a year-by-year analysis of the scheme's impacts, as shown in the following equation:

$$y_{i,t} = \alpha + \sum_{t=1998, t\neq 2002}^{2008} \beta_t (Sector_i \times Year_t) + \phi Year_t + \gamma Sector_i + X_{i,t}\sigma + \lambda g_{i,t} + u_{i,t} \tag{2}$$

Where $Year_t$ is a dummy variable for each year, and the coefficients β_t capture the effect of the scheme on the labor supply of central government employees in each year compared to the year 2002 and municipality

employees.

To account for potential sector-specific trends, I further extend the model using a Difference-in-Difference-in-Differences (DiDiD) framework. This approach introduces a third dimension—age group—by comparing the labor supply of 61-65-year-olds (eligible for the scheme) with that of 56-60-year-olds (ineligible). This comparison across both sectors and age groups allows to control for sector-specific trends that may bias the results.

$$\begin{aligned} y_{i,t} = &\alpha + \beta(Sector_i \times Post_t \times AgeGrp_i) + \delta(Sector_i \times Post_t) \\ &+ \gamma(Sector_i \times AgeGrp_{i,t}) + \phi(Post_t \times AgeGrp_{i,t}) \\ &+ \theta Sector_{i,t} + \mu Post_t + \nu AgeGrp_{i,t} + \lambda g_{i,t} + X_{i,t}\sigma + u_{i,t} \end{aligned} \tag{3}$$

In this model, $AgeGrp_{i,t}$ is a dummy variable indicating if the individual belongs to the 56-60 or 61-65 age group. The coefficient β captures the differential impact of the scheme by comparing labor supply across both sectors and age groups, ensuring sector-specific trends are properly accounted for.

Lastly, I extend the DiDiD model for a yearly analysis to capture the scheme's impact over time:

$$\begin{aligned} y_{i,t} = &\alpha + \sum_{t=1998, t\neq 2002}^{2008} \beta_t(Sector_i \times Year_t \times AgeGrp_{i,t}) \\ &+ \sum_{t=1998}^{2008} \delta_t(Sector_i \times Year_t) + \sum_{t=1998}^{2008} \gamma_t(Year_t \times AgeGrp_{i,t}) \\ &+ \sum_{t=1998}^{2008} \phi_t Year_t + \theta Sector_i + \mu AgeGrp_{i,t} + \lambda g_{i,t} + X_{i,t}\sigma + u_{i,t} \end{aligned} \tag{4}$$

In this model, β_t represents the effect of the scheme for each year compared to the reference year 2002, municipality employees, and ineligible younger individuals (aged 56-60).

I estimate Equations 1 through 4 using Ordinary Least Squares (OLS) for binary outcomes and Poisson regression for continuous variables. Although logarithmic or inverse hyperbolic sine transformations are commonly applied to continuous outcomes, they can introduce unit dependency issues, particularly when variables like earnings include zero values (Chen & Roth, 2024). Poisson regression mitigates this issue by providing percentage changes at the mean level rather than individual levels.

6 Main results

6.1 Overall impact on earnings per capita and employment rate

To evaluate the effect of the partial retirement scheme, I focus on two outcome variables: average earnings per capita—which includes non-workers by attributing zero earnings to them—and the employment rate. Average earnings per capita incorporates both the intensive margin (earnings conditional on employment) and the extensive margin (employment rate). Table 5 presents the estimated effects of the partial retirement scheme on average earnings per capita and employment rate, as derived from the models outlined in Equations (1) through (4). The corresponding graphical illustration, based on the DiDiD estimation from Equation (4), is shown in Figure 3.

Columns (1) and (3) present the effects of the scheme on the earnings per capita of central government employees aged 61-65, using DiD and DiDiD estimations, respectively. Both estimations show a 6.5% reduction in earnings per capita, indicating that incorporating younger individuals (aged 55-60) as an additional control layer in the DiDiD model does not alter the effect estimated by the DiD model. This suggests that the within-sector variation does not introduce bias into the estimation. Columns (2) and (4) indicate that the scheme's impact intensified over time until year 2006. This increase corresponds with the rising number of granted partial pensions, as depicted in Figure 1.

Columns (5) and (7) examine the scheme's effect on employment among central government employees aged 61-65, using DiD and DiDiD estimations, respectively. Both models estimate a 1.9 percentage point reduction in the employment rate, with the effect intensifying over time. This increasing impact on the employment rate suggests that, as individuals begin to work part-time, they develop a stronger preference for early retirement, leading to more frequent transitions to full retirement and a further reduction in the employment rate.

6.2 Decomposing Earnings per Capita: Intensive and Extensive Margins

Figure 4 breaks down the total changes in earnings per capita into two components: the extensive margin (employment rate) and the intensive margin (earnings conditional on employment). This decomposition is based on the following equation:

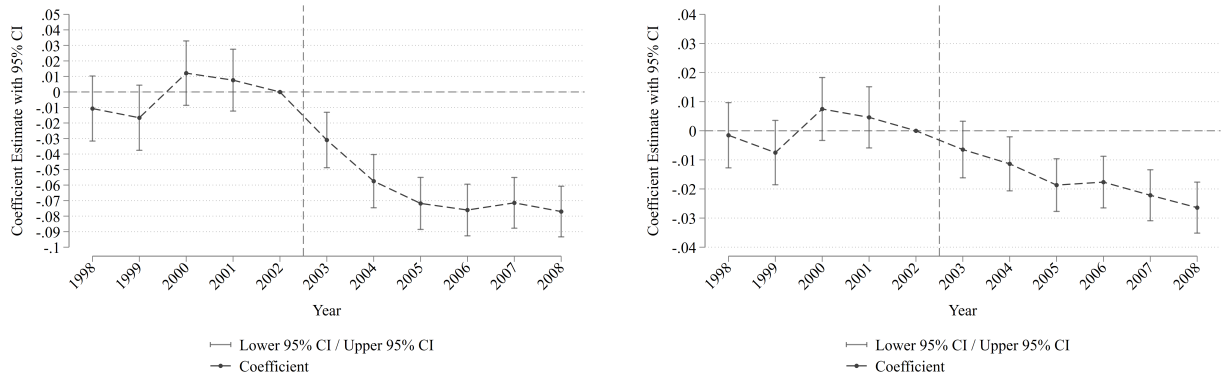
$$\text{Earnings per capita} = \frac{\text{Employment}}{\text{Population}} \times \text{Earnings per worker} \tag{5}$$

In this equation, earnings per capita is represented as the product of the employment rate (share of the working population) and earnings per worker. Consequently, the percentage change in earnings per capita

Table 5: The Effect of the Partial Retirement Scheme on Earnings per Capita and Employment Rate of 61-65-year-old Employees.

	Earnings per capita				Employment rate			
	DiD		DiDiD		DiD		DiDiD	
	Pre-post	Year×Sector	Pre-post	Year×Sector×Age group	Pre-post	Year×Sector	Pre-post	Year×Sector×Age group
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	-0.0652***		-0.0653***		-0.0193***		-0.0190***	
	(0.0038)		(0.0041)		(0.0021)		(0.0021)	
1998		0.0007		-0.0093		0.0018		-0.0001
		(0.0099)		(0.0106)		(0.0055)		(0.0057)
1999		-0.0158		-0.0186		-0.0057		-0.0056
		(0.0100)		(0.0106)		(0.0055)		(0.0012)
2000		0.0324**		0.0124		0.0130*		0.0091
		(0.0099)		(0.0105)		(0.0053)		(0.0055)
2001		0.0075		0.0086		0.0027		0.0054
		(0.0095)		(0.0100)		(0.0052)		(0.0053)
2002		Ref.		Ref.		Ref.		Ref.
2003		-0.0238**		-0.0310***		-0.0047		-0.0050
		(0.0084)		(0.0090)		(0.0048)		(0.0049)
2004		-0.0604***		-0.0553***		-0.0092*		-0.0094*
		(0.0080)		(0.0086)		(0.0046)		(0.0047)
2005		-0.0640***		-0.0720***		-0.0150***		-0.0176***
		(0.0078)		(0.0084)		(0.0044)		(0.0046)
2006		-0.0608***		-0.0756***		-0.0178***		-0.0160***
		(0.0077)		(0.0084)		(0.0044)		(0.0045)
2007		-0.0646***		-0.0721***		-0.0225***		-0.0206***
		(0.0076)		(0.0082)		(0.0043)		(0.0045)
2008		-0.0708***		-0.0775***		-0.0274***		-0.0250***
		(0.0076)		(0.0082)		(0.0043)		(0.0045)
	727,076	727,076	1,668,554	1,668,554	727,076	727,076	1,668,554	1,668,554

Notes: This table provides regression analyses on the effect of the partial retirement scheme on earnings per capita and employment rate among 61- to 65-year-old central government employees. Columns (1) to (4) display results from Equation 1 to Equation 4 for earnings per capita, and Columns (5) to (8) show the estimations from Equation 1 to Equation 4 for employment. Earnings are adjusted for 2010 prices. The employment indicator is set to 1 for employees who have earnings more than 1 price base amount in 2010 (SEK 42 400). Continuous outcome variables are estimated using a Poisson model, while binary outcome variables are estimated with OLS. All regressions include control variables as listed in Table A.3. Standard errors are reported in parentheses. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.



(a) Earnings per Capita

(b) Employment rate

Figure 3: The Effect of the Partial Retirement Scheme on Earnings per Capita and Employment Rate

Notes: Figures (a) and (b) illustrate the effects of the partial retirement scheme on central government employees aged 61-65, using estimates from Equation (4) for earnings per capita and employment rate, respectively. Earnings are adjusted for 2010 prices. The employment indicator equals 1 for employees whose earnings exceed one price base amount in 2010 (SEK 42,400). Continuous outcome variables are estimated using a Poisson model, while binary outcome variables are estimated with OLS. All regressions include control variables listed in Table A.3. Confidence intervals are set at 95 percent.

can be approximated as the sum of the percentage changes in these two elements:

$$\Delta\%\text{Earnings per capita} \approx \Delta\%\frac{\text{Employment}}{\text{Population}} + \Delta\%\text{Earnings per worker} \tag{6}$$

Figure 4 and Table A.5 illustrate the percentage changes for each component in Equation 6. The percentage change in earnings per capita and employment rate has already been presented in Section 6.1.[20] The change in earnings per worker, the third component, is estimated using the DiDiD model in Equation 4, where the outcome variable is earnings for those who remain employed. Note that the estimated percentage changes in employment rate and earnings per worker do not sum up exactly to estimated percentage changes in earnings per capital due to compositional changes, as those who retire and stay employed post-2003 may not have the same average earnings prior to 2003.

Figure 4 shows that the introduction of the partial retirement scheme leads to a 6.5% reduction in total earnings per capita. Approximately 60% of this reduction is due to employees reducing their working hours by shifting from full-time working to part-time working under the partial pension scheme (intensive margin). The remaining 40% is attributed to a decrease in employment, as employees who opt for partial retirement and work part-time, gradually lose their attachment to the labor market, and subsequently retire earlier (extensive margin).

6.3 Interpretation and discussion of findings

The negative effect of the partial retirement scheme on the intensive margin (average earnings per worker) and the extensive margin (employment rate) can be attributed to both supply-side (employees) and demand-side (employers) factors.

First, regarding average earnings per worker, the overall reduction in average earnings is mainly driven by partial pension recipients who, without the scheme, would likely have continued working full-time. With access to the partial pension; however, these individuals transition to part-time work, thereby decreasing their average earnings. This decline in average earnings among partial pension recipients outweighs any positive effects from those who, in the absence of the scheme, might have reduced their working hours even further than they do under partial retirement.

On the supply side, partial retirement is financially favorable for employees. The reduction in income is proportionally smaller than the reduction in working hours (Arbetsgivarverket, 2003a,b), and the impact on final pension benefits is minimal (Hallberg, 2008), making part-time work more appealing than full-time employment. As a result, employees perceive the financial costs of switching from full-time to part-time

20. To estimate the percentage change in employment rate, Section6.1 shows that the employment rate fell by approximately 1.9 percentage points following the introduction of partial retirement in 2003. Given a pre-2003 employment rate of nearly 80% among central government employees aged 61-65 (see Table 4), this corresponds to a roughly 2.4% reduction in employment.

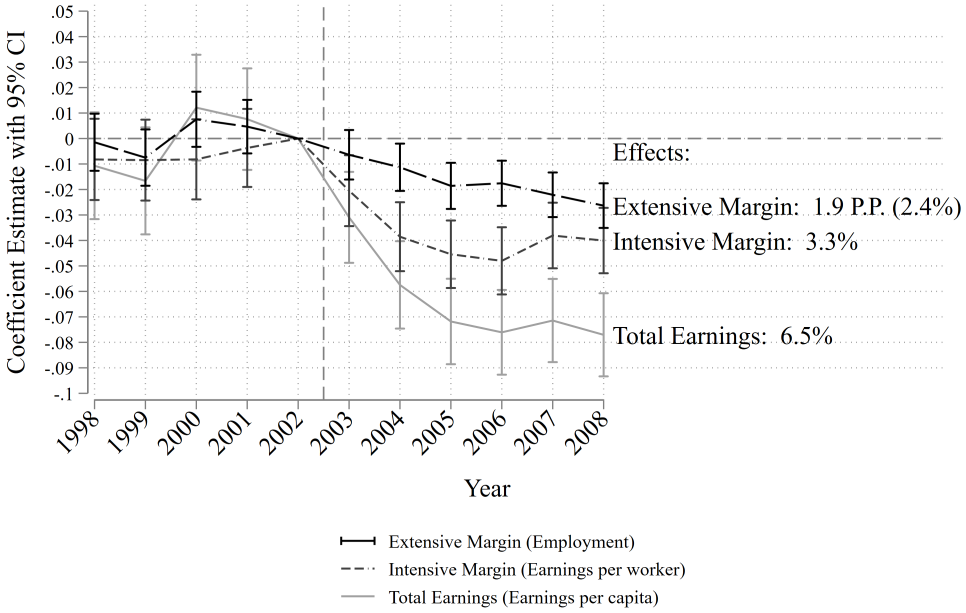


Figure 4: Decomposition of the Effect on Earnings per Capita into Extensive (Employment Rate) and Intensive (Earnings per Worker) Margins

Notes: This figure presents the decomposition of the total effect of the partial retirement scheme on earnings per capita into two components: the extensive margin (employment rate) and the intensive margin (earnings per worker). The coefficients plotted for each year are estimated using Equation (4). The average effects shown in the figure are estimated using Equation (3), incorporating interactions between post-treatment, sector, and age group indicators. The outcome variable for earnings per capita includes all individuals, with non-workers counted as having zero earnings. The extensive margin is based on a binary indicator set to 1 if an individual's earnings exceed the 2010 price base amount (SEK 42,400), while the intensive margin captures earnings only for those with positive earnings. The sample consists of individuals aged 61 to 65 from 1998 to 2008. Continuous outcome variables are estimated using a Poisson model, while binary outcome variables are estimated with OLS. All regressions include control variables listed in Table A.3. Standard errors are shown in parentheses. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

work to be very low, which encourages them to opt for part-time work. This shift leads to a reduction in working hours reflecting a decline in labor supply intensity.

Demand factors could also explain the reduction in earnings. For employers, granting partial pensions to full-time employees has certain financial advantages. When no new recruitment occurs, employers reduce their costs of paying employees' wages (Arbetsgivarverket, 2003b; Riksrevisionen, 2008). Additionally, employees often do not reduce their work effort to the same extent as their working time decreases (Riksrevisionen, 2008), which further lowers the need for new recruitment. By granting partial pensions to employees who would otherwise work full-time, employers effectively facilitate a reduction in working hours, contributing to the overall decrease in labor supply intensity.

Second, regarding the employment rate, the negative effect on the employment rate indicates that the impact of employees transitioning to part-time work and, subsequently, exiting the labor market earlier outweighs the positive effect of those who continue working part-time instead of retiring. The negative effect on the employment rate could also be attributed to a mix of supply and demand factors.

On the supply side, part-time work reduces attachment to the labor market, increases the preference for leisure, and ultimately encourages earlier retirement, leading to a reduction in the employment rate. On the demand side, employers may need to either close or adjust their business; therefore, they might have an interest in firing older employees who are less productive. However, the Employment Protection Act (LAS) in Sweden allows employees the right to work until age 67.[21] The main rule of the LAS is "last in, first out", which means that older employees enjoy more robust protection than younger employees. In response, employers may offer partial retirement plans, with an implicit or explicit understanding that employees will retire completely shortly thereafter (Riksrevisionen, 2008). By receiving partial pensions and transitioning to part-time work, employees effectively expedite their full retirement. This practice, while beneficial for immediate cost-saving, contributes to a decrease in employment rate as more employees exit the labor market earlier than they might have without the option of partial retirement (Albanese et al., 2020; Graf et al., 2011).

7 Additional results

7.1 Substitution effect

The introduction of the partial retirement scheme may influence the take-up of other social insurance programs within Sweden's income security system. This system consists of a public pension system and mandatory labor market insurance programs, including unemployment insurance (UI), sickness insurance (SI), and disability insurance (DI). UI is accessible to actively job-seeking unemployed individuals, while SI and DI are provided to employees with temporary and permanent working capacity loss, respectively. Although SI primarily aims to ensure income losses from temporary illnesses,[22] extended periods of illness have become more common, making the program a significant pathway for individuals exiting the labor force (Karlström et al., 2008; Palme & Svensson, 2004).

SI and DI are alternative pathways to retirement that can become more attractive to employees after introducing a partial retirement scheme. Employees can combine partial retirement with SI or DI, provided they work at least 50% of their full-time work and do not receive a partial pension for the portion covered by SI or DI.[23] However, employees may prefer to substitute SI or DI with partial retirement due to more favorable terms of partial retirement. If this substitution effect dominates the effect of combining programs, resulting in a lower net take-up rate of SI and DI, the government could reduce spending on funds allocated to these programs.

21. Employment protection increased to age 68 in 2019 and to age 69 in 2023. Before 2002, employment protection was provided up to age 65

22. Employees are not required to apply for SI for the initial 14 days (extended to 21 days after 2003). The employer covers the lost income during this period.

The replacement rate for SI[24] and DI[25] are 77.6% and 64.6%, respectively. Partial retirement substitutes 60% of one's lost income based on one's average earnings of the last five years before receiving the partial pension. Although the replacement rate for partial retirement is lower than that for SI or DI, partial retirement offers the advantage of being available until age 65 without needing further assessments. The SI replaces the share of lost earnings due to temporary illnesses up to the social security ceiling. If the loss of working ability is not considered temporary, then individuals should transition to DI.

The scheme's effect on transitions from employment to SI or DI is estimated using the following difference-in-difference model:

$$TR_{i,t} = \alpha + \beta(Sector_i \times Post_t) + \phi Post_t + \gamma Sector_i + X_{i,t}\sigma + \lambda g_{i,t} + u_{i,t} \tag{7}$$

Where $TR_{i,t}$ is a binary variable equal to 1 if an individual, for the first time, receives DI or SI in year t, conditional on working in year $t-1$. The outcome variable accounts for the transition into either SI or DI, as DI is an alternative for those who cannot continue receiving SI or were initially ineligible for it. The model is estimated using OLS.

Additionally, I extend Equation 7 to assess the year-specific effects of the scheme on SI or DI take-up rates, using the following specification:

$$TR_{i,t} = \alpha + \sum_{t=1998, t\neq 2002}^{2008} \beta_t(Sector_i \times Year_t) + \phi Year_t + \gamma Sector_i + X_{i,t}\sigma + \lambda g_{i,t} + u_{i,t} \tag{8}$$

Table A.2 summarises the estimations obtained from Equation 7 and 8. Column (1) in Table A.2 indicates a reduction of 0.37 percentage points in the transition from employment to SI or DI. Considering that the pre-2003 transition rate was 5.8%, this reduction translates to a statistically significant 6.4% drop in the transition rate. Figure 5 and Column (2) demonstrate that the transition from employment to SI or DI gradually decreased after the scheme's introduction; however, the reduction died out in the following years. The short-lived effect of the scheme can be attributed to the initial generosity of the partial retirement scheme, which primarily offered partial pensions at 50%. As the scheme has evolved, the majority of partial

23. Employees can receive DI at various percentages (25%, 50%, 75%, and 100%), which correspond to different degrees of loss (Johansson et al., 2014). Hence, since they are required to work at least 50% to receive a partial pension, the combination of DI with partial retirement is feasible only if they receive 25% DI.

24. The replacement rate for SI has undergone several adjustments over the years. Initially set at 90% of the pensionable income in 1987, it was reduced to 75% in 1996. It was increased to 80% after 1988 but was again reduced in 2003 to 77.6%.

25. DI provides 64.7% of the average of the best five to eight years of pensionable income prior to a worker's eligibility for DI. Eligibility for DI requires a permanent reduction in work capacity of at least 25%, and full compensation necessitates the complete or almost complete loss of capacity. The eligibility rules for DI were tightened in 2003, requiring the assessment of work capacity against the entire labor market (Johansson et al., 2014).

pensions have been reduced to 20% (refer to Table 2). This change has likely influenced employees' preferences, leading them to initially consider partial retirement as a more favorable option than SI or DI but reverting to SI or DI as the terms of partial retirement became less advantageous.

Supporting this finding, Riksrevisionen (2008) reviewed the implementation of the scheme in 2007. The study reports that many employees use partial retirement to replace previous sickness insurance. In addition, several employers in the review stated that the motivation for granting partial pensions is to prevent or reduce the risk of extended absence in the form of sick leave.

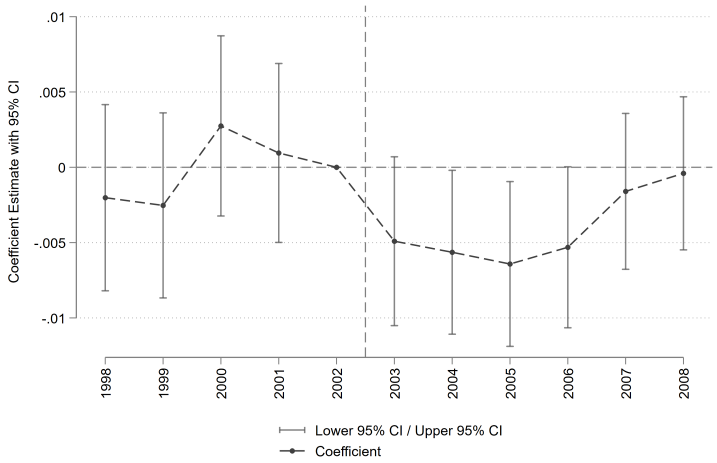


Figure 5: The Effect of the Partial Retirement Scheme on Transition to Sickness Insurance or Disability Insurance

Notes: This figure presents the estimated effect of the partial retirement scheme on the transition from employment to sickness or disability insurance for employees aged 61-65. The coefficients are estimated using Equation 7. The outcome variable is a binary variable equal to 1 if an individual, for the first time, receives DI or SI in year t, conditional on working in year $t-1$. The outcome variable accounts for the transition into either SI or DI, as DI is an alternative for those who cannot continue receiving SI or were initially ineligible for it. The model is estimated using OLS. The sample covers 61 to 65 individuals from 1998 to 2008.

7.2 Age-Specific effects

While this paper primarily focuses on the effect of the partial retirement scheme on employees aged 61 to 65, who are eligible for partial retirement, extending the analysis to examine its effect across individual age groups up to 70 allows for a more detailed understanding of how the scheme influences the labor supply of employees working beyond the eligibility age of 64. After age 64, employees' labor supply may increase due to experiencing less pressure from part-time work (Ahn, 2016; Gielen, 2009); however, it can also decrease due to losing attachment to the labor market because of part-time work or signaling to employers a preference for early retirement (Machado & Portela, 2012).

Equation 9 estimates the scheme's effect across different age groups from 56 to 70:

$$
\begin{aligned}
y_{i,t} =& \alpha + \sum_{Age=56, Age\neq 60}^{70} \beta_t (Sector_i \times Age_{i,t} \times Post_t) \\
&+ \sum_{Age=56}^{70} \delta_t (Sector_i \times Age_{i,t}) + \sum_{Age=56}^{70} \gamma_t (Age_{i,t} \times Post_t) \\
&+ \sum_{Age=56}^{70} Age_{i,t} + \theta Sector_i + \mu Post_t + \lambda Year_t + X_{i,t}\sigma + u_{i,t}
\end{aligned} \tag{9}
$$

In this model, β_t captures the effect of the scheme on central government employees at each age relative to municipality employees, using age 60 as the reference group. The estimation is carried out using Poisson regression.

Figure 6 shows that the scheme has no significant effect on the earnings per capita of employees younger than 60, who are ineligible for partial pensions. However, starting at age 61, the earnings of central government employees begins to decline relative to that of municipality employees after the scheme's implementation in 2003. The negative effect of the scheme on the labor supply increases over age and reaches its peak at age 64.

Furthermore, the scheme has no significant effect on earnings for individuals older than 65, after the partial retirement period ends. These findings suggest there is no lasting impact on earnings from working part-time under the scheme.

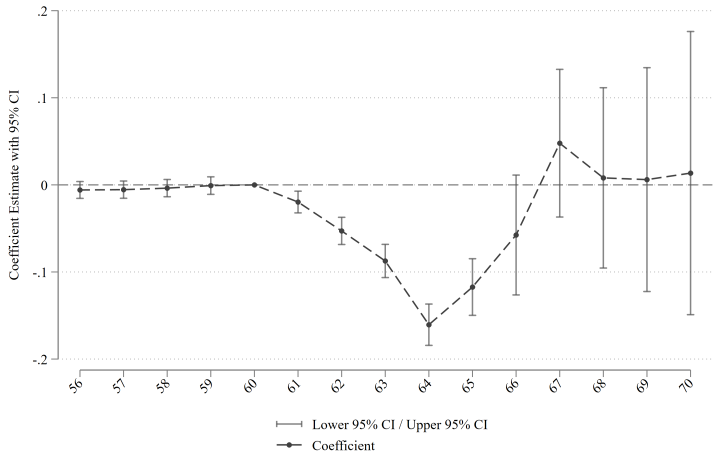


Figure 6: The Effect of the Partial Retirement Scheme on Earnings Across Age

Notes: The figure illustrates the effect of the partial retirement scheme on the average earnings per capita of central government employees, using Poisson regression estimates derived from Equation 9. The analysis includes individuals from 1998 to 2008, aged 56 to 70, comparing labor supply outcomes across age groups between the treatment group (central government employees) and the control group (municipality employees). The vertical line marks the introduction of the scheme in 2003. The regression is estimated using a Poisson model, with controls for variables listed in Table A.3. Earnings per capita are adjusted for inflation and expressed in 2010 SEK. Confidence intervals are set at 95%.

8 Heterogeneous effects

The labor supply effects of the partial retirement scheme may differ across various population subgroups. This section examines potential heterogeneity by assessing how the scheme's impact varies by gender, education, earnings, sickness status, and marital status.

The analysis is conducted using the following regression model, where the interaction term between $Post_t \times Sector_i$ has further interacted with different subgroups of interest:

$$\begin{aligned} y_{i,t} &= \alpha + \beta(Sector_i \times Post_t \times \gamma_i) + \delta(Sector_i \times Post_t) \\ &+ \gamma(Sector_i \times \gamma_i) + \phi(Post_t \times \gamma_i) \\ &+ \theta Sector_i + \mu Post_t + \nu\gamma_i + \lambda g_{i,t} + X_{i,t}\sigma + u_{i,t} \end{aligned} \tag{10}$$

In this equation, γ_i is a dummy variable for the subgroups of interest, while the remaining variables are as defined in the main specification (Equation 1).

Table 6 summarizes the estimated effects of the scheme obtained from Equation 10. Columns (1) to (5) present results for the interactions with the following subgroups: female, highly educated, those who received sickness insurance at age 60, individuals with earnings above the median, and individuals who are married or living with a partner.

Column (1) reveals that male employees' earnings decrease by 4.01% following the scheme's implementation. For females, there is an additional 2.90% reduction, amounting to an overall 6.91% (4.01% + 2.90%) decline. This stronger effect for women can be attributed to their greater likelihood of working part-time rather than full-time, a trend observed across both the EU and Sweden (Eurofound, 2016; Reday-Mulvey, 2005). In Sweden specifically, 38% of women aged 55–64 years were working part-time in 2002, compared to only 14% of men (Eurofound, 2016; Reday-Mulvey, 2005). This higher prevalence of part-time work among women makes them more directly affected by the partial retirement scheme, amplifying its impact on their earnings.

Women's greater tendency to work part-time can be attributed to various factors, including their prioritization of work (Duncan et al., 2003; Hakim, 2002) or family and leisure activities (Björk et al., 2020). Part-time work is also a common coping strategy when job demands are high, particularly in female-dominated occupations (Drange & Egeland, 2014; Eurofound, 2016). Health issues are another significant driver, as Lanninger & Sundström (2013) found that women in Nordic countries often choose part-time work due to health-related challenges. Additionally, even though the responsibility for caring for older adults in Sweden lies primarily with the municipality rather than individuals, women still assume a larger share of caregiving duties, which

can further influence their working hours (Ulmanen & Szebehely, 2015).

Column (2) reveals that highly educated individuals (those with at least a 3-year university degree or higher) experience a 1.91% earnings increase after the partial retirement scheme's implementation, whereas lower-educated individuals see a 9.5% reduction. This difference could be attributed to financial necessity or the physical demands of their respective jobs.

Highly educated individuals often have greater accumulated financial security, enabling them to reduce their working hours from full-time to part-time under partial retirement without significant financial strain, leading to a decrease in their overall labor supply. In contrast, partial retirement provides lower-educated individuals with an opportunity to maintain income while transitioning out of full-time work, thereby increasing their labor supply (Beehr & Bennett, 2015). Additionally, highly educated individuals typically hold white-collar, less physically demanding jobs, making it feasible to continue full-time work until retirement age. However, when partial retirement becomes available, they may prefer to reduce their hours, resulting in a decline in labor supply. Conversely, lower-educated individuals are more likely to hold physically demanding roles, which makes full-time work at older ages increasingly challenging. Partial retirement thus provides them a way to work part-time, easing physical demands without fully retiring and thereby increasing their labor supply (Van Solinge & Henkens, 2005).

Column (3) highlights that the scheme primarily affects individuals with earnings above the median. High-income employees are better positioned to absorb income reductions from part-time work, enabling them to shift from full-time to part-time working under the partial retirement scheme to enjoy more leisure.

Column (4) demonstrates that after the implementation of the partial retirement scheme, the labor supply of employees who had received sickness benefits at age 60 decreases by 6.1% (-8.72%+2.52%), compared to an 8.6% decrease for employees who had not received sickness benefits. This result suggests that individuals with a history of sickness are more likely to experience ongoing health issues and, as a result, may have reduced their working hours even without the partial retirement scheme. Consequently, the scheme has a less pronounced effect on their labor supply, as many of these individuals may have already chosen to shift from full-time to part-time work due to health constraints, independent of the scheme's availability.

Finally, column (5) shows that married or partnered individuals experience a 3.51% greater reduction in their earnings following the partial retirement scheme compared to single, widowed, or divorced individuals. This difference may result from the income pooling opportunity available to partnered individuals, where one partner reduces working hours while relying on the other's income for financial security (Zhang, 2014). In addition, married individuals, compared to unmarried, may have incentives to use partial retirement

opportunities to coordinate joint retirement with their spouses (Johnsen et al., 2022; Kruse, 2021; Lalive & Parrotta, 2017). Furthermore, as couples age, one partner may need to assume caregiving duties for the other. The partial retirement scheme provides these individuals with the flexibility to reduce work hours gradually while managing caregiving responsibilities (Costa-Font & Vilaplana-Prieto, 2023). Consequently, partnered individuals have stronger incentives to reduce their working hours through partial retirement than those who are unmarried.

Table 6: Heterogeneous Effects of the Partial Retirement Scheme

	(1) Gender	(2) Education	(3) Earnings	(4) Sickness	(5) Married/With partner
Sector=1 × Post=1	-0.0401***	0.0191**	0.00255	-0.0872***	-0.0390***
	(0.00522)	(0.00681)	(0.00592)	(0.0122)	(0.00633)
Sector=1 × Post=1 × Female=1	-0.0290***				
	(0.00748)				
Sector=1 × Post=1 × Highly educated=1		-0.114***			
		(0.00827)			
Sector=1 × Post=1 × High income=1			-0.103***		
			(0.00727)		
Sector=1 × Post=1 × Previously sick=1				0.0252*	
				(0.0128)	
Sector=1 × Post=1 × Married=1					-0.0363***
					(0.00783)
Observation	727,076	727,076	727,076	727,076	727,076

Notes: This table presents the heterogeneity analysis of the partial retirement scheme's effect on earnings per capita using Equation 10. Columns (1) to (5) correspond to different subgroups: gender, education, earnings, sickness, and marital status. The interaction term $Sector_i \times Post_t \times \gamma_i$ captures subgroup-specific effects. The sample consists of 61-65-year-old employees from 1998 to 2008. Standard errors are reported in parentheses. The regression is estimated using a Poisson model, with control variables listed in Table A.3. Earnings per capita are adjusted for inflation and expressed in 2010 SEK. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

9 Threats to identification

To validate the robustness of the findings, a series of checks are performed, focusing on the definition of the treatment group and potential confounding factors from other concurrent reforms. These tests aim to eliminate alternative explanations and confirm that the observed effects are driven by the partial retirement scheme.

9.1 Excluding Sector Switchers

In the main analysis, treatment and control groups are defined by an employee's sector affiliation at age 60, one year before becoming eligible for partial retirement. However, it is crucial to consider that some

employees may change sectors after the age of 60. Notably, 7% of central government employees and 6% of municipality employees switched to either the private sector or another public sector after age 60. The majority of these switchers are employees who left the public sector and moved to the private sector. Table 7 shows the effect of the scheme after dropping employees who switched their sectors. The effects are slightly larger compared to the main findings. These results might be due to the loss of central government employees who reduced their working hours through partial retirement and subsequently transitioned to the private sector, leading to a stronger effect when they are excluded from the analysis.

Table 7: The Effect of the Partial Retirement Scheme on Earnings per Capita and Employment Rate of 61- to 65-Year-Old Employees, Excluding Sector Switchers

Earnings per capita		Employment rate	
DiD	DiDiD	DiD	DiDiD
-0.0761***	-0.0784***	-0.0207***	-0.0199***
(0.00397)	(0.00429)	(0.00220)	(0.00227)
663,460	1,560,567	663,460	1,560,567

Notes: This table provides the estimated effects of the partial retirement scheme on earnings per capita and employment rate on 61-65-year-old central government employees, excluding those employees who have switched their sectors after age 60. The first and third columns display the results from Equation 1 for earnings per capita and employment rate, respectively. The second and fourth columns apply Equation 3. Earnings are adjusted for 2010 prices. The employment indicator is set to 1 for employees who have earnings of more than 1 price base amount in 2010 (SEK 42 400). Continuous outcome variables are estimated using a Poisson model, while binary outcome variables are estimated with OLS. All regressions include control variables as listed in Table A.3. The sample covers the data from 1998 to 2008. Standard errors are reported in parentheses. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

9.2 Governments' efforts to reduce part-time unemployment

Since the late 1990s, the Swedish government has undertaken measures to address part-time unemployment and improve the status of part-time employees (Riksrevisionen, 2006). These efforts have involved changes in work organizations and the regulation of compensation for part-time unemployment, with the aim of transitioning part-time employees to full-time positions (Riksrevisionen, 2006).[26]

Notably, the government's ambition to shift part-time employees to full-time roles can potentially influence the observed effect of the partial retirement scheme. Given that the proportion of part-time employees is greater in the municipality (control group) than in the central government (treatment group), the govern-

26. In 1997, an EU agreement (European Union, 1997) granted part-time unemployed individuals preferential access to higher employment rates. The EU's part-time work directives were integrated into Swedish law in 2002, coinciding with Sweden's ratifying of an ILO convention to strengthen part-time employee positions. In February 1999, the "Delta investigation" proposed rule changes, activities, and support mechanisms (Regeringskansliet, 1999). Later that year, the Health Commission suggested measures to facilitate recruitment in the health sector (Riksdagen, 1999). Further investigations in April 2004 (Riksdagen, 2004b) and October 2004 (Riksdagen, 2004a) focused on enhancing the right to full-time work and the right to leave to reduce working hours, respectively. In 2003, the government allocated SEK 150 million to the "Hella" project, targeting part-time unemployment (Sveriges Kommuner och Regioner, 2002).

ment's initiative might have a more pronounced impact on increasing full employment in the control group than in the treatment group. Therefore, there is a risk of misinterpreting the stronger increase in the earnings of municipality employees, resulting from a transition of part-time employees to full-time status, as a negative effect of the partial retirement scheme.

However, there are two reasons to believe that the observed effects are primarily driven by the partial retirement scheme rather than the government's efforts to reduce part-time employment. First, if government initiatives had disproportionately increased full-time employment in the control group compared to the treatment group, these trends would be visible across all age groups, including employees aged 56-60. Yet, as shown in Table 4, the average earnings per capita and employment rate differences between the central government and municipality employees remain stable for the younger group, suggesting that the effects are specific to older employees aged 61-65 who were subject to the partial retirement scheme. Moreover, although the government's effort to increase full employment began in the 1990s, Table 5 shows that the estimated effects only emerge after 2003, coinciding with the introduction of the partial retirement scheme.

Second, utilizing aggregate data from Statistics Sweden, Figure 7 illustrates a declining trend in the proportion of part-time employees among all employees in the municipality from 2000 to 2008 for employees aged 60-64 years. However, a comparable trend is observed in the central government during the same period. This suggests that while government initiatives have led to a reduction in the share of part-time employees, a parallel trend is evident in the treatment group. Notably, the share of part-time employees in the central government has increased since 2003, which is attributable to the partial retirement scheme in the central government.

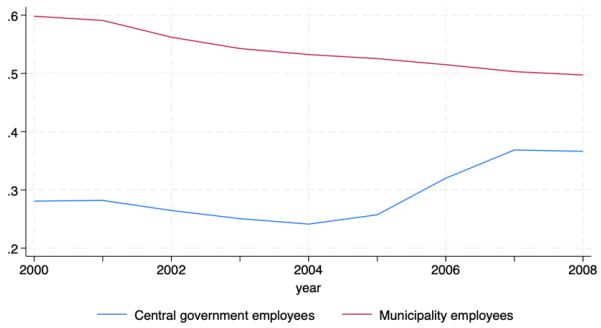


Figure 7: Share of Part-Time Employees Among All Employees in the Municipality and Central Government Sector Aged 60-64

Note: The y-axis represents the share of part-time employment among all employed individuals, and the x-axis shows the year. These shares are calculated using aggregate data from Statistics Sweden.

9.3 Occupational pension reform in the municipality sector

As discussed in Section 3, individuals exposed to the 2001 occupational pension reform in the municipality sector were excluded from the analysis. To ensure this exclusion does not bias the main results, Table 8 demonstrates including these individuals in the analysis results in only a marginal impact on the estimated effects on earnings per capita and employment rate.

Table 8: Effect of Partial Retirement Scheme on Earnings and Employment Rate, Including Municipality Employees Affected by Pension Reform

	Earnings per capita		Employment rate	
	DiD	DiDiD	DiD	DiDiD
	-0.0761***	-0.0781***	-0.0207***	-0.0192***
	(0.00397)	(0.00424)	(0.00220)	(0.00226)
N	1,157,942	2,959,359	1,157,942	2,959,359

Notes: This table provides the estimated effect of the partial retirement scheme on earnings per capita and employment of 61-65-year-old central government employees, excluding those who were employed in the occupations that were exposed to the occupational pension reform. The first and the third columns display results from DiD for earnings per capita and employment rate, respectively. The second and fourth columns apply DiDiD. Earnings are adjusted for 2010 prices. The employment rate indicator is set to 1 for employees with earnings exceeding one price base amount in 2010 (SEK 42,400). A Poisson model is used for earnings per capita, while OLS is applied for the employment rate. All regressions include control variables listed in Table A.3. Standard errors are shown in parentheses. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

10 Concluding remarks

How does partial retirement, i.e., allowing individuals to work part-time while receiving a significant portion of their previous wage, affect labor supply? Labor supply could increase if individuals work more hours or stay employed longer instead of retiring early. However, it could decrease if individuals use partial retirement to transition gradually into retirement. I examined these effects in Sweden, which provides a clean, empirical setting for this analysis. Since 2003, central government employees in Sweden aged 61-65 have been able to work part-time while still receiving a significant portion of their previous wage. The findings show that earnings per capita among central government employees aged 61-65 declined by 6.5% after the scheme's introduction. About 60% of this reduction is due to employees reducing their working hours (intensive margin), while the remaining 40% is due to a decrease in the employment rate (extensive margin).

These results suggest that while *flexible social security schemes* are often regarded as beneficial for providing work flexibility (Ameriks et al., 2020; Kantarci & Van Soest, 2008; Reday-Mulvey, 2023), they can lead to a decline in labor supply. The observed reduction in the labor supply due to the introduction of the partial

retirement scheme can be attributed to both supply and demand factors. From the employee perspective, partial retirement is financially favorable. The decrease in income is proportionally smaller than the reduction in working hours (Arbetsgivarverket, 2003a,b), and the impact on final pension benefits is minimal (Hallberg, 2008), making part-time work more appealing than full-time employment. For employers, granting partial pensions to full-time workers can lead to lower wage expenses, especially when hiring new employees is not necessary (Arbetsgivarverket, 2003b; Riksrevisionen, 2008). In addition, while employers might need to adjust their business operations, Sweden's Employment Protection Act (LAS) allows employees to work until age 67, presenting partial retirement as a strategic option for employers to manage wage costs effectively (Albanese et al., 2020; Graf et al., 2011). This study, therefore, provides a comprehensive understanding of how partial retirement schemes influence work patterns, considering both the employee and employer perspectives.

In addition to affecting labor supply, partial retirement can influence other existing social security programs like sickness insurance (SI) and disability insurance (DI). This aspect contributes to the broader understanding of *how public policies interact*. The literature has previously documented program spillover of pension reforms (Duggan et al., 2007; Johnsen et al., 2022; Karlström et al., 2008), and the findings of this paper align with these observations. Specifically, this research reveals a 6.4% decrease in the share of employees transitioning from employment to SI or DI following the implementation of the partial retirement scheme. This reduction suggests that partial retirement schemes with favorable terms can be perceived as better alternative pathways to retirement, such as SI or DI, potentially easing the financial burden on social security programs.

Furthermore, this study addresses methodological challenges in *partial and gradual retirement literature*. Earlier studies suffered from issues such as the inability to establish proper control groups or potential selection biases at the firm or municipality level (e.g., Albanese et al., 2020; Berg et al., 2020; Graf et al., 2011; Huber et al., 2016; Kantarcı et al., 2023; Wadensjo, 2006). This study overcomes these issues by leveraging the quasi-experimental design of the scheme and employing a DiDiD approach to compare central government employees across sectors and age groups, effectively controlling for potential confounding factors.

In light of new insights into social security reforms, public policy interactions, and partial retirement schemes, this study has significant *implications for employers* in Sweden and other countries. It underscores the need for employers, particularly in the central government, to recognize that the primary goal of a partial retirement scheme is to increase labor supply. According to Riksrevisionen (2008), employers have not sufficiently explored the possibility of adapting tasks and work organizations to meet the changing needs of older employees. In this context, granting a partial pension can be seen as a simple solution where employers do not attempt other solutions that may have less negative effects on the labor supply. To ensure that the partial retirement scheme leads to an increased labor supply, employers should equip themselves with more knowl-

edge to assess in which context and to which employees they should grant partial pension. The employer should review how the application of partial retirement could be developed to increase the labor supply to a greater degree than it is today. One possible assessment could involve discussing the possibility of adopting tasks and work before granting a partial pension.

Moreover, this study has important *implications for policy makers* in Sweden and other countries. This paper finds that Sweden's partial retirement terms particularly incentivize employees to choose part-time retirement over full-time employment. Consequently, when designing similar schemes, policymakers should be aware of the need to balance terms that motivate potential early retirees toward part-time work while not compelling full-time employees to reduce their work hours. This approach could involve adjusting financial incentives, modifying eligibility criteria, or offering additional benefits that specifically address the needs and preferences of older employees who cannot or do not want to continue working.

Looking forward, this study needs to be viewed in light of *recent developments in retirement policies* in Sweden. In 2023, the Swedish Employment Agency and unions collectively agreed to phase out partial retirement eligibility for employees born in 1966 and later. Instead, a 1.5% contribution to a premium-based *flexible pension*[27] was introduced. Even though the financial impact of flexible pensions for those retiring in the short term is limited, it can become increasingly important after 30 years as insurance capital grows and younger generations reach retirement age. In addition, flexible pensions make it easier for employees to reduce their working hours because the premium is already paid and does not entail any additional direct costs for the employer. The flexible pension earned can be used before retirement to reduce one's working hours, potentially extending the working life of employees. However, it could also be added to the future pension, resulting in a greater final pension benefit and, thus, a lower retirement age. Investigating the overall impact of these two contrasting effects could be an interesting question for future research.

Declaration of competing interest

The author of this paper declares no conflict of interest.

Data availability

The data obtained from Statistics Sweden (SCB) and the State Occupational Pensions Agency (SPV) have been crucial for this study. These data have been utilized in accordance with the regulations provided by

27. *Flexible pension* and *partial pension* are frequently used interchangeably; however, flexible pension, and sometimes *part-time pension*, refer to defined contribution pensions. In contrast, a partial pension mainly denotes a defined benefit pension (Pensionsmundigheten, 2017).

Statistics Sweden. The author is not authorized to share the data.

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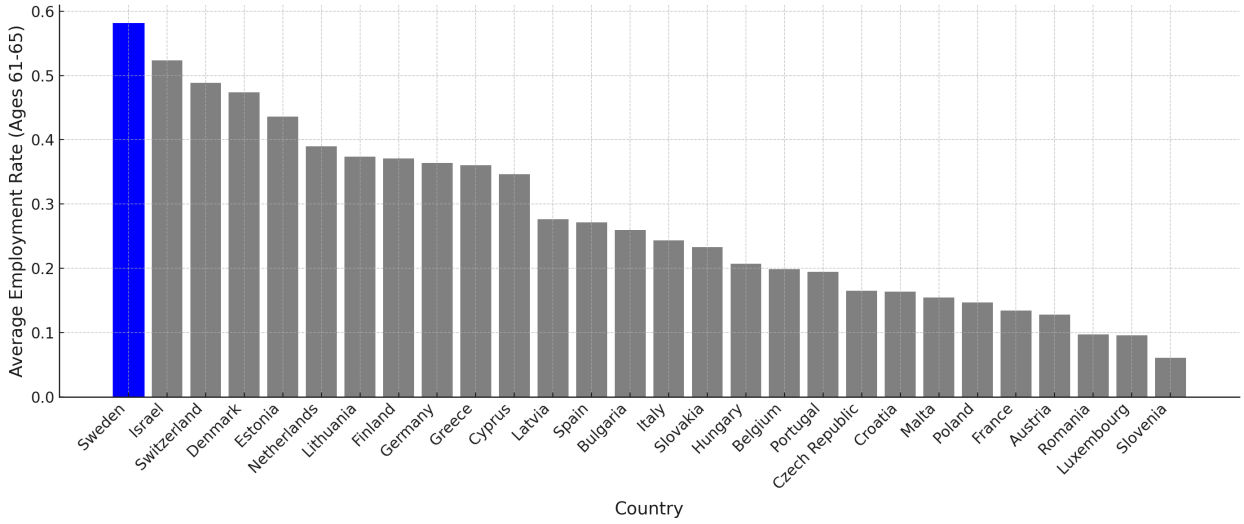
Appendix



A.1: Average Employment Rate for Aged 61-65

Notes: This figure displays the employment rate across several European countries. The data is sourced from SHARE (Survey of Health, Ageing and Retirement in Europe) for the years 2010 to 2020.

A.1: Comparison of Studies on Labor Supply Effects of Partial Retirement Schemes in Europe

Article	**Country**	**Scheme**	**Years**	**Early Retirement Age**	**Part-time Eligibility Age**	**Empirical Strategy**	**Effect on Labor Supply**	**Replacement Rate**
Ilmakunnas & Ilmakunnas (2006)	Finland	Part-time pension	1987 (private) 1989 (public)	63	58-67	Multivariate Probit	No significant impact on extension of working life	50% reduction in wage
Albanese et al. (2020)	Belgium	Time Credit (TC)	2002	60	50+	Survival Analysis	Initial rise, followed by a drop in employment probability	83% for 80% working hours, 57% for 50%
Graf et al. (2011)	Austria	Old Age Part-Time (OAPT)	2000	56.5 (women) 61.6 (men)	50 (women) 55 (men)	Matching	Increased employment probability two years post-entry; reduced total hours	Up to 76% of original wage
Berg et al. (2020)	Germany	Altersteilzeit (ATZ)	1996	60	55+	DiD	Men work an additional 0.6 years, women 1.1 years	60%-85% of original wage
Huber et al. (2016)	Germany	Altersteilzeit (ATZ)	1996	60	55+	DiD	5-6% rise in employment rate among men in Eastern Germany	60%-85% of original wage
Hermansen (2015)	Norway	Contractual Pension (AFP)	2016	62	62	DiD	No significant effect on labor supply	Varies with HR manager support
Rutten et al. (2022)	Netherlands	Gradual Retirement Plans (GRP)	2014	66	55-62 (varies by municipality)	DiD	Labor supply increase by 7 weeks annually	Varies across municipalities
Wadensjo (2006)	Sweden	Part-time pension	1976-2000	61	60 (61 after 1994)	Panel data	Average weekly increase of 4.23 hours for ages 61-65	50%-65% reduction in wage

Note: This table summarizes studies on the labor supply effects of partial retirement schemes in Europe, detailing early and part-time eligibility ages, empirical strategies, observed effects on labor supply, and replacement rates.

A.2: Effect of the Partial Retirement Scheme on the Transition from Employment to Sickness or disability insurance for 61- to 65-Year-Old Employees.

	DiD			
	Post×Sector		Year×Sector	
	(1)		(2)	
2003-2008	-0.00372**	(0.00121)		
1998			-0.00202	(0.00315)
1999			-0.00253	(0.00313)
2000			0.00275	(0.00305)
2001			0.000951	(0.00303)
2002			Ref.	
2003			-0.00491	(0.00286)
2004			-0.00564*	(0.00278)
2005			-0.00642*	(0.00279)
2006			-0.00531	(0.00273)
2007			-0.00160	(0.00264)
2008			-0.000401	(0.00259)
Mean dep. var.	.058			
Observation	727,076		727,076	

Notes: This table displays regression results assessing the impact of the partial retirement scheme on the transition from employment to Sickness Insurance (SI) or Disability Insurance (DI) for central government employees aged 61-65. Columns (1) and (2) present findings from Equations 7 and 8, respectively. The variable $TR_{i,t}$ is a binary indicator equal to 1 if an individual receives DI or SI for the first time in year t, conditional on being employed in year $t-1$. Standard errors are provided in parentheses, and the model is estimated using Ordinary Least Squares (OLS). The sample includes individuals aged 61 to 65 from 1998 to 2008. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

A.3: Descriptive Statistics for the Treatment and Control Groups of 61-65 years old employees

(a) 61-65 years old	1998-2002			2003-2008			
	Treatment	Control	Diff	Treatment	Control	Diff	Diff-in-Diff
Years of schooling	12.996	13.272	-0.276***	13.116	13.374	-0.257***	0.018
	(2.890)	(2.259)	[<.001]	(2.857)	(2.128)	[<.001]	[0.173]
Wealth (SEK)	1,144,044	903,828	240,216***	1,528,409	1,222,938	305,470***	65,254***
	(2,595,932)	(1,296,715)	[<.001]	(3,236,762)	(1,664,662)	[<.001]	[<.001]
Males	0.589	0.380	0.209***	0.547	0.382	0.165***	-0.045***
	(0.490)	(0.485)	[<.001]	(0.498)	(0.486)	[<.001]	[<.001]
Number of children home	0.027	0.018	0.009***	0.142	0.130	0.012***	0.002
	(0.200)	(0.167)	[<.001]	(0.433)	(0.412)	[<.001]	[0.178]
Single	0.084	0.071	0.014***	0.112	0.094	0.019***	0.005**
	(0.280)	(0.256)	[<.001]	(0.316)	(0.291)	[<.001]	[0.001]
Married	0.678	0.685	-0.007***	0.647	0.667	-0.020***	-0.013***
	(0.470)	(0.464)	[<.001]	(0.478)	(0.471)	[<.001]	[<.001]
Divorced	0.056	0.071	-0.015***	0.046	0.052	-0.006***	0.010***
	(0.230)	(0.257)	[<.001]	(0.210)	(0.222)	[<.001]	[<.001]
Widowed	0.182	0.173	0.009***	0.194	0.187	0.007***	-0.002
	(0.390)	(0.379)	[<.001]	(0.396)	(0.390)	[<.001]	[0.396]
Public administration and defense	0.570	0.158	0.412***	0.587	0.185	0.403***	-0.010***
	(0.500)	(0.365)	[<.001]	(0.492)	(0.388)	[<.001]	[<.001]
Education	0.148	0.461	-0.314***	0.166	0.525	-0.359***	-0.046***
	(0.350)	(0.498)	[<.001]	(0.372)	(0.499)	[<.001]	[<.001]
Real estate and business activity	0.134	0.026	0.108***	0.125	0.022	0.103***	-0.005***
	(0.340)	(0.158)	[<.001]	(0.331)	(0.147)	[<.001]	[<.001]
Health and social work	0.014	0.181	-0.167***	0.010	0.120	-0.110***	0.057***
	(0.120)	(0.385)	[<.001]	(0.101)	(0.325)	[<.001]	[<.001]
Transportation, storage and communication	0.059	0.007	0.052***	0.041	0.004	0.037***	-0.015***
	(0.240)	(0.084)	[<.001]	(0.199)	(0.066)	[<.001]	[<.001]
Other community and social service activities	0.020	0.066	-0.046***	0.022	0.056	-0.035***	0.011***
	(0.140)	(0.248)	[<.001]	(0.146)	(0.231)	[<.001]	[<.001]
Other occupations	0.016	0.051	-0.035***	0.018	0.046	-0.028***	0.007***
	(0.120)	(0.220)	[<.001]	(0.134)	(0.209)	[<.001]	[<.001]
N	82,840	176,014	258,854	160,525	307,697	468,222	727,076

Notes: This table presents descriptive statistics for various variables across treatment and control groups for individuals aged 61-65, before and after the introduction of the partial retirement scheme in Sweden. The Diff columns show the differences between treatment and control groups within each time period (1998-2002 and 2003-2008). The Diff-in-Diff column represents the difference-in-differences (DiD), capturing the impact of the pension reform by comparing the changes over time between treatment and control groups. Standard deviations are reported in parentheses and p-values in brackets. Statistical significance is denoted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

A.4: Descriptive Statistics for the Treatment and Control Groups of 56-60 years old employees

(b) 56-60 years old	1998-2002			2003-2008			
	Treatment	Control	Diff	Treatment	Control	Diff	Diff-in-Diff
Years of schooling	13.105	13.370	-0.264***	12.941	13.368	-0.426***	-0.162***
	(2.836)	(2.137)	[<.001]	(2.770)	(2.048)	[<.001]	[<.001]
Wealth (SEK)	1,018,304	805,669	212,634***	1,221,366	1,033,944	187,421***	-25,212
	(2,117,969)	(1,230,087)	[<.001]	(3,480,542)	(4,473,460)	[<.001]	[0.121]
Males	0.552	0.384	0.168***	0.515	0.370	0.145***	-0.023***
	(0.497)	(0.486)	[<.001]	(0.500)	(0.483)	[<.001]	[<.001]
Number of children at home	0.094	0.078	0.016***	0.311	0.322	-0.010***	-0.026***
	(0.370)	(0.337)	[<.001]	(0.641)	(0.647)	[<.001]	[<.001]
Single	0.114	0.093	0.020***	0.147	0.128	0.019***	-0.002
	(0.317)	(0.291)	[<.001]	(0.354)	(0.334)	[<.001]	[0.288]
Married	0.662	0.686	-0.024***	0.638	0.659	-0.021***	0.003
	(0.473)	(0.464)	[<.001]	(0.481)	(0.474)	[<.001]	[0.186]
Divorced	0.031	0.036	-0.004***	0.027	0.027	0.000	0.004***
	(0.174)	(0.185)	[<.001]	(0.163)	(0.163)	[0.847]	[<.001]
Widowed	0.193	0.185	0.008***	0.188	0.186	0.002*	-0.006**
	(0.395)	(0.388)	[<.001]	(0.391)	(0.389)	[0.029]	[0.001]
Public administration and defense	0.587	0.181	0.405***	0.599	0.205	0.394***	-0.011***
	(0.492)	(0.385)	[<.001]	(0.490)	(0.403)	[<.001]	[<.001]
Education	0.164	0.521	-0.357***	0.175	0.544	-0.368***	-0.012***
	(0.371)	(0.500)	[<.001]	(0.380)	(0.498)	[<.001]	[<.001]
Real estate and business activity	0.127	0.022	0.105***	0.104	0.021	0.083***	-0.022***
	(0.333)	(0.147)	[<.001]	(0.305)	(0.143)	[<.001]	[<.001]
Health and social work	0.010	0.124	-0.114***	0.011	0.107	-0.095***	0.018***
	(0.102)	(0.330)	[<.001]	(0.106)	(0.309)	[<.001]	[<.001]
Transportation, storage and communication	0.041	0.005	0.036***	0.044	0.003	0.041***	0.005***
	(0.199)	(0.069)	[<.001]	(0.204)	(0.053)	[<.001]	[<.001]
Other community and social service activities	0.022	0.057	-0.035***	0.020	0.050	-0.030***	0.005***
	(0.147)	(0.232)	[<.001]	(0.139)	(0.218)	[<.001]	[<.001]
Other occupations	0.018	0.048	-0.030***	0.017	0.038	-0.021***	0.009***
	(0.132)	(0.213)	[<.001]	(0.128)	(0.190)	[<.001]	[<.001]
N	130,612	251,112	381,724	191,284	368,470	258,854	941,478

Notes: This table presents descriptive statistics for various variables across treatment and control groups for individuals aged 56-60, before and after the introduction of the partial retirement scheme in Sweden. The Diff columns show the differences between treatment and control groups within each time period (1998-2002 and 2003-2008). The Diff-in-Diff column represents the difference-in-differences (DiD), capturing the impact of the pension reform by comparing the changes over time between treatment and control groups. Standard deviations are reported in parentheses and p-values in brackets. Statistical significance is denoted as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

A.5: Decomposition of the Effect on Earnings per Capita into Extensive (Employment Rate) and Intensive (Earnings per Worker) Margins

	Earnings per capita	Earnings per worker	Employment rate
Post×Sector× Age group	–0.0652***	-0.0334***	-0.0190***
	(0.0041)	(0.0031)	(0.0021)
Observations	1,668,554	1,473,975	1,668,554

Notes: This table presents the decomposition of the total effect of the partial retirement scheme on earnings per capita into intensive (earnings per worker) and extensive (employment rate) margins. The coefficients for each outcome are estimated using a Difference-in-Differences-in-Differences (DiDiD) approach in Equation (3), with interactions between post-treatment, sector, and age group indicators. The sample includes individuals aged 61 to 65, with observations spanning from 1998 to 2008. The outcome variable for earnings per capita includes all individuals, treating non-workers as having zero earnings. The intensive margin (earnings per worker) is calculated only among individuals with positive earnings, while the extensive margin (employment rate) uses a binary indicator set to 1 if an individual's earnings meet or exceed the 2010 price base amount (SEK 42,400). Standard errors are shown in parentheses. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.