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The effect of age-targeted tax credits on retirement behavior

Lisa Laun

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The effect of age-targeted tax credits on retirement behavior[a]

by

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Abstract

This paper analyzes the effect of two age-targeted policy initiatives to delay retirement that were simultaneously implemented in Sweden in 2007: an earned income tax credit and a payroll tax credit. Both policies were targeted at workers aged 65 or above at the beginning of the tax year. The paper exploits that the special rules for elderly were governed by the year of birth while the social security system is governed by age at retirement, i.e., the day of birth, in analyzing the effect of the new policies. The results suggest that the age-targeted tax credits increased employment in the year following the 65th birthday by 1.5 percentage points among individuals with annual earnings above the 2007 tax liability threshold three to five years earlier. An analysis of fiscal implications indicates, however, that the increase in employment was not large enough to offset the implied decrease in tax revenues.

Keywords: Labor supply, retirement, earned income tax credit, payroll taxes
JEL-codes: H24, J14, J18, J21

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Table of contens

1 Introduction

A key remedy for the fiscal pressure of an aging population, facing many developed countries, is to delay retirement. The main approach to encourage a delayed labor force exit has been through social security reform. The financial incentives for early retirement inherent in many social security systems, as shown in Gruber and Wise (1999), have been removed in many countries and age limits have been increased. An alternative approach, that has not yet been widely used, is to adjust labor tax rates close to the retirement age. If the labor supply elasticity near retirement is large, as suggested by French (2005), the cost of reduced tax rates might be offset by the revenue from an increased tax base. If the elasticity is small, reduced labor tax rates for older workers will merely work as a transfer to individuals who would have continued to work regardless.

In 2007, the Swedish government introduced two different labor tax credits for workers aged 65 or above at the beginning of the tax year, with the purpose to promote work at older ages. The first was an earned income tax credit introduced for all workers, that was substantially larger for workers above age 65. The additional tax credit for a worker at the 25th percentile of the earnings distribution, aged 65 at the beginning of 2007, amounted to about 9 percent of net earnings. The second was a payroll tax credit that reduced the payroll tax rate by about 16 percentage points. This paper studies if the age-targeted labor tax credits for workers above age 65 affected retirement behavior. The identification strategy exploits that individuals who turn 65 just before or just after the new year face different labor tax rates at essentially the same age. Public pension benefits, on the other hand, are determined by the age at retirement and other differences between the groups can be controlled for using a difference-in-differences approach, to the extent that they do not change discontinuously at the time of the reform. The sample consists of individuals who turned 65 from November to February between 2001 and 2009.

The results suggest that the age-targeted tax credits increased employment in the year following the 65th birthday by 1.5 percentage points, increased earnings as a share of previous earnings by 1.8 percentage points and increased the number of remunerated months by 0.133 among individuals with annual earnings above the 2007 tax liability threshold

three to five years earlier. The results are shown to be robust to various specification tests. An analysis of heterogeneous responses indicates that the effects are primarily driven by men and are particularly large for self-employed. In an attempt to study the relative importance of the two types of tax credits the variation in the size of the credits by income and year is being used, but the analysis gives no conclusive result. From a policy perspective, the changes in retirement behavior induced by the reform appear to be moderate. The public finance costs of the tax credits are large, and rough calculations suggest that the benefits from the behavioral changes are not large enough to account for reform costs.

This study relates to three branches of the previous literature. The first branch is the impact of financial incentives on the retirement decision, which has mainly focused on the effects of social security provisions.[1] The second is the impact of earned income tax credits on labor supply. The focus has been on the Earned Income Tax Credit in the U.S. and the Working Families Tax Credit in the U.K., mainly targeted towards low income families.[2] The Swedish earned income tax credit has primarily been assessed in simulation studies in which workers above age 65 have been excluded.[3] Edmark, Liang, Mörk and Selin (2012) use a quasi-experimental approach and conclude that the impact of the Swedish earned income tax credit for workers below age 65 is difficult to evaluate. The third branch of the previous literature is the effect of payroll taxation on employment.[4]

The paper makes two main contributions to the previous literature. First, although there is a large literature on the effect of social security systems on retirement behavior and a growing literature on labor market responses to different earned income tax credit and payroll tax initiatives, it is, to the author's knowledge, the first paper to study the effect of income tax policy changes on retirement behavior. As argued in Blundell and MaCurdy (1999), the participation decision is likely the most responsive margin of labor supply. This motivates reforms directly aimed at increasing participation among certain types of workers with potentially elastic labor supply; an often targeted group has been low income families. This paper studies how targeted income tax reforms affect another group with a

[1] See Lumsdaine and Mitchell (1999) for a review.
[2] See Eissa and Hoynes (2006) and Blundell and Hoynes (2004) for reviews.
[3] See, e.g., Aaberge and Flood (2008), Ericson and Flood (2009) and Sacklén (2009).
[4] See, e.g., Gruber (1997), Bohm and Lind (1993), Bennmarker, Mellander and Öckert (2009).

potential labor supply reserve, namely workers at the margin of retirement. Second, the identification strategy, which exploits differences in the organization of the income tax and the social security systems with respect to cohort versus age based incentives, has not been previously used in the empirical public finance literature.

The study also contributes to the intense public policy debate in Europe and elsewhere on how to increase labor supply at older ages. Although the challenge of aging populations is not new, the question has gained importance in the wake of the financial crisis. The results in the paper suggest that social security reform is not the only way to enhance the incentives for a delayed labor force exit. Another approach is to consider the incentives in the income tax system, that affect the gains from working directly. From a public finance perspective, changing the rules in the social security system may be less costly than introducing financial incentives for work through tax credits. However, policies aimed at encouraging individuals who are healthy enough to continue working are likely easier to promote than forcing regulations for delayed retirement.

The results may also be informative of the effectiveness of the Swedish earned income tax credit in general, given that no quasi-experimental study has been successful in evaluating the reform. This paper studies the impact for workers who are already in the labor market, who have the right to stay at their job until age 67 and who are likely to have an elastic extensive margin labor supply. If there would be no effects for this group, it is unlikely that the earned income tax credit for workers below age 65 would get unemployed workers, who are likely to face much larger labor demand restrictions, into employment.

The paper is organized as follows. Section 2 describes the structure of the age-targeted tax credits and retirement institutions. Section 3 discusses the theoretical predictions. Section 4 outlines the empirical strategy and Section 5 describes the data. Section 6 presents the empirical results and Section 7 concludes the paper.

2 Institutional setting

2.1 The age-targeted labor tax credits

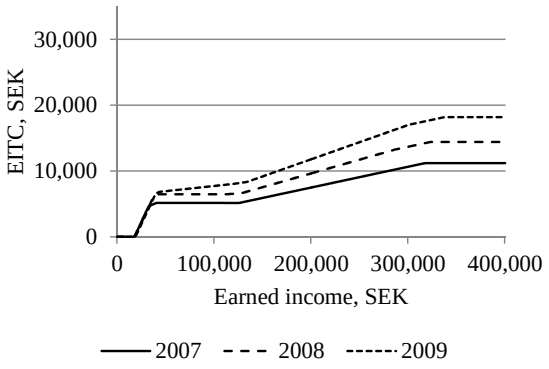
The individual is the tax-paying unit in the Swedish income tax system. Individual income is subject to a personal income tax that consists of a proportional local government tax and a progressive central government tax. The taxable income is the sum of labor and transfer income reduced by a standard deduction, that is phased in at low incomes and phased out at high incomes, and a deduction for certain costs of acquiring income. The local government tax rate varies across Sweden's 290 municipalities, ranging from 26.5 to 34.41 percent with an average rate of 31.55 percent in 2007. The central government tax schedule has two thresholds, with a tax rate of 20 percent above the first and 25 percent above the second threshold.[5]

The first labor tax credit studied in this paper is an earned income tax credit that reduced the personal income tax on labor income only. It was introduced on 1 January 2007 for workers of all ages, with the purpose of increasing the returns from working relative to collecting public transfers. Motivated by the particular importance of encouraging older workers to remain in the labor force, the tax credit was substantially larger for workers aged 65 or above at the beginning of the tax year. Apart from age, the size of the tax credit was a function of the earned income, the standard deduction and the local government tax rate. It was a non-refundable credit that could not reduce the local government tax liability below zero and was deducted automatically on the monthly paycheck. The earned income tax credit was expanded in 2008, 2009 and 2010. Due to data availability, this paper focuses on the period 2007–2009.

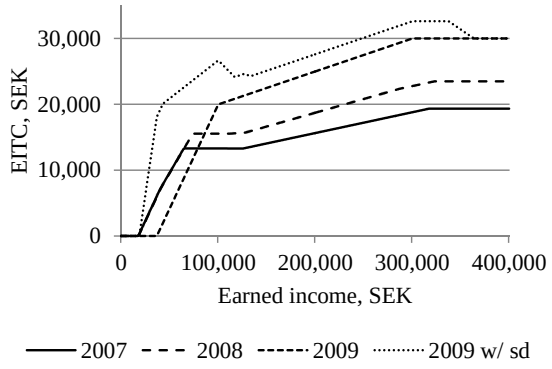
Figure 1 presents the structure of the earned income tax credit during 2007–2009, assuming the average local tax rate and no taxable transfers.[6] Figures 1(a) and 1(b) show the earned income tax credit as a function of earned income for workers who are below

[5] In 2007, the standard deduction ranged from SEK 17,100 to 31,100 ($ 2,400 to 4,400). The first threshold for the central government tax was SEK 316,700 ($ 45,200) and the second threshold was SEK 476,700 ($ 68,100). Throughout the paper, I use an exchange rate of 7 SEK for 1 USD.

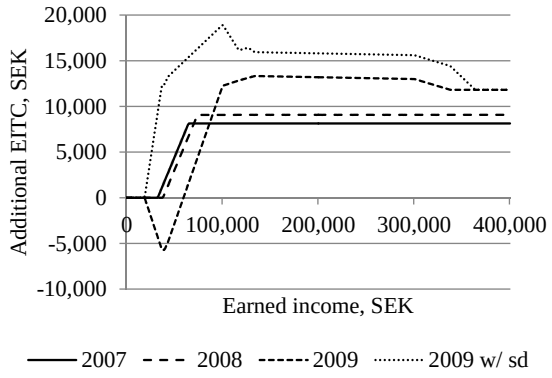
[6] The EITC depends on taxable transfers through the standard deduction. The assumption of no taxable transfer is strong for individuals above age 65 of which more than 90 percent collect public pension. Larger taxable transfers will, however, only slightly increase the difference in credit amounts for workers below and above age 65 presented in Figure 1(c).



(a) EITC below age 65



(b) EITC above age 65



(c) Additional EITC above age 65

Figure 1: The earned income tax credit as a function of earned income 2007–2009, below age 65 in (a), above age 65 in (b), additional tax credit above age 65 in 1(c), with and without additional standard deduction in 2009

or above age 65 at the beginning of the tax year. Unlike most earned income tax credits in other countries, there was no phase-out region of the credit. In 2007 and 2008, the shape of the tax credit schedule was the same for workers below and above age 65, but the larger initial phase-in region made the tax credit substantially more generous for the older age group. In 2009, an additional standard deduction for workers above age 65 was introduced. The earned income tax credit for older workers was therefore made independent of the standard deduction and the shape of the tax credit changed. Since the additional standard deduction applied to transfer income as well as labor income it did not explicitly encourage work, and the analysis in this paper can therefore be argued to capture the difference that is due to the earned income tax credit per se.

Figure 1(c) shows the difference in tax amounts for workers above compared to below age 65, with and without the additional standard deduction in 2009. The additional tax credit for workers above age 65 increased slightly from 2007 to 2008 and increased substantially from 2008 to 2009, except in the interval where the additional standard deduction limited the tax liability of older workers. Between the tax liability thresholds for workers below and above age 65 in 2009, the tax credit is zero for older workers and positive for younger workers, which explains the negative difference in this interval. For an employed worker at the 25th percentile of the earnings distribution who was aged 65 at the beginning of the tax year, the additional earned income tax credit amounted to 9.1 percent of net earnings in 2007, 9.6 percent in 2008 and 12 percent in 2009.[7] The earned income tax credit for older workers thus substantially increased the gains from continued work.

Labor income is also subject to a proportional payroll tax levied on all wages paid out by employers. The payroll tax includes a general wage tax and specific contributions to various social insurance programs. The benefits to which an individual is entitled increase with the level of income up to a cap that varies across programs. For income below the cap, the payroll tax can hence partly be seen as an insurance premium. Eligibility for disability and unemployment benefits ceases on the 65th birthday, however, and access to

[7]Employment is defined as having annual earnings above one income base amount (see Section 5 for details and data). Earnings at the 25th percentile of the earnings distribution among workers aged 65 at the beginning of the year was SEK 89,200 in 2007, 95,100 in 2008 and 102,800 in 2009.

sickness benefits is restricted after that age. The payroll tax rate has therefore traditionally been slightly lower for individuals aged 65 or above at the beginning of tax year. The lower rate has been cohort-specific because of the introduction of the new pension system, described in the next section.

Figure 2: The payroll tax rate by age at the beginning of the tax year 2001–2009

The second labor tax credit studied in this paper is a payroll tax credit that further reduced the tax rate for workers aged 65 or above at the beginning of the tax year. Like the earned income tax credit, it was introduced on 1 January 2007. *Figure 2* presents the payroll tax rate by age at the beginning of the tax year during 2001–2009. The normal payroll tax rate in 2007 was 32.42 percent for regular employers and 30.71 percent for self-employed. The payroll tax rate for workers above age 65 was slightly lower even before 2007 but was reduced from 26.37 percent in 2006 to 10.21 percent in 2007. Since then, it only includes pension contributions. The payroll tax credit thus reduced the payroll tax rate for older workers by 16.16 percentage points. Also this reform was motivated by the importance of promoting work among older workers. While the earned income tax credit was aimed at stimulating labor supply, the purpose of the payroll tax credit was to stimulate labor demand. It could, for example, compensate for productivity declines or workplace accommodations.

2.2 Retirement institutions

In Sweden, the decision to retire from the labor force is separate from public pension collection, in the sense that there are no restrictions on the size of labor earnings when collecting income-related public pension. The marginal tax rate increases with total income, however, and guaranteed pension is means-tested. The mandatory retirement age, i.e., the age at which an employer can ask an employee to leave an employment, is determined in collective agreements but the minimum level is regulated under the Employment Protection Act. In 2001, the minimum mandatory retirement age in Sweden increased from 65 to 67. Legally, the retirement decision at age 65 among employed workers is therefore in the hands of the individual.

The Swedish public pension system was reformed during the late 1990s. The minimum retirement age under the old system was 61 and the normal retirement age was 65. For each month before age 65 that the individual collected old-age pension, benefits were reduced by 0.5 percent, and for each month after age 65 that the individual postponed collecting pension, benefits were increased by 0.7 percent. Under the new pension system, the minimum retirement age is also 61 but there is no normal retirement age. Income-related pension benefits are calculated by adjusting the notional account balance at the time of retirement by an annuity divisor that is based on life expectancy and a real rate of return during the expected life of the annuity. Guaranteed pension can be collected from the 65th birthday. Although there is no normal retirement age, most people start collecting public pension when turning 65. In 2007, about 20 percent of individuals collected public pension in the year they turned 64 while more than 90 percent collected public pension in the year they turned 65.

The old public pension system was a defined benefit scheme consisting of a flat-rate basic pension and an income-related supplementary pension based on the best 15 out of 30 years of earnings. The new system is a combination of notional defined contributions on a pay-as-you-go basis and a smaller financial defined contribution scheme. Individuals with small or no pension claims receive a guaranteed pension. The main factor determining pension benefits is the age at retirement, through the actuarial adjustments

described above, but there is a cohort-based element through the phase-in of the new pension scheme. The 1938 cohort was the first to receive pension from the new scheme, with 4/20 of their pension benefits from the new scheme and 16/20 from the old scheme. Each successive cohort receives an additional 1/20 from the new scheme and 1/20 less from the old scheme. Individuals born in 1954 or later are completely in the new scheme. The phase-in of the new public pension system is thus very slow and the size of the incentives change is the same for each cohort. The exception is the 1938 cohort aged 65 at the beginning of 2003, i.e., well before the age-targeted tax credits were introduced.

3 Theoretical framework

To discuss the theoretical predictions of the age-targeted labor tax credits, I distinguish between the *gross* wage w paid by the employer, the *taxable* wage z received by the worker and the *net* wage c consumed by the worker. According to economic theory, the incidence of taxation does not depend on which side of the market the tax is levied, but will fall mostly on the group for which the response to price changes is least elastic. *Figure 3* presents the potential effects of the tax credits in a simple model of supply and demand in the labor market. The earned income tax credit increases the net wage of workers and shifts the labor supply curve from S_0 to S_1, which reduces the taxable wage from z_0 to z_1 and increases employment from E_0 to E_1. The payroll tax credit lowers labor costs and shifts the labor demand curve from D_0 to D_1, which increases the taxable wage from z_0 to z_2 and increases employment from E_0 to E_1. Combined, the two tax credits shift both the labor supply and labor demand curve to the new equilibrium given by E_2 and z_0, resulting in increased employment but with an ambiguous effect on taxable wages. The magnitude of the employment effect and the sign and magnitude of the wage effect depend on the relative elasticities of labor supply and labor demand, i.e., the relative slopes of the two curves.[8]

In a market with perfect competition, the gross wage equals the marginal product

[8] Summers (1989) and Gruber (1997) point out that if payroll tax revenues are used to finance programs which benefit workers, the tax-benefit linkage will shift labor supply outwards as well, since the tax is buying workers benefits. Workers above age 65 were not eligible to the programs the payroll tax financed before the reform, however, so there was no tax-benefit linkage.

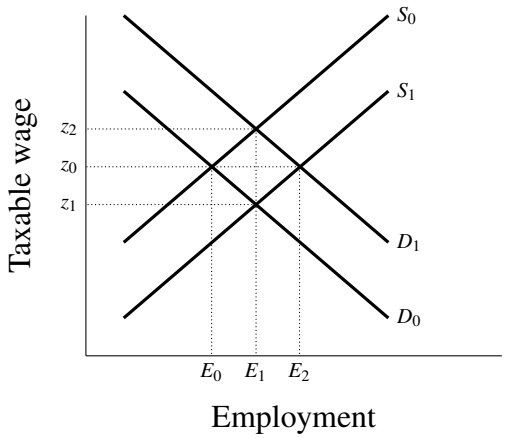


Figure 3: The incidence of taxation

of the worker. Labor demand is hence infinitely elastic, which implies that the full tax incidence falls on the worker. In the standard static labor supply model, the individual maximizes the utility from consumption and leisure subject to a budget constraint. Following Lehmann, Marical and Rioux (2011), I denote one minus the labor income tax rate the net-of-income-tax rate and one minus the payroll tax rate the net-of-payroll-tax rate. On a linear part of the payroll tax schedule, $z = \tau^P w + R^P$, where τ^P is the marginal net-of-payroll-tax rate and R^P is the virtual taxable income. Likewise, on a linear part of the income tax schedule, $c = \tau^I z + R^I$, where τ^I is the marginal net-of-income-tax rate and R^I is the virtual net income. Combining these expressions gives the individual budget constraint if the full tax incidence falls on the worker:

$$c = \tau^I \tau^P w + \tau^I R^P + R^I. \tag{1}$$

The average net-of payroll-tax rate is given by $\rho^P = z/w = \tau^P + R^P/w$ and the average net-of-income-tax rate is given by $\rho^I = c/z = \tau^I + R^I/z$. In this model, labor supply depends on the global marginal net-of-tax rate $\tau = \tau^I \tau^P$, the global virtual income $R = \tau^I R^P + R^I$ and the global average net-of-tax rate $\rho = c/w = \rho^P \rho^I$.

There are several reasons for why the above description may not hold. Labor market frictions resulting in imperfect competition could limit the adjustment of taxable wages. Wage negotiations typically take place with a lag and taxable wages may be rigid due

to, for example, union bargaining. If so, it does matter to which side of the market the tax is levied. The payroll tax credit would accrue to the employer and potentially affect employment through increased demand for labor, although empirical findings suggest that the employment effects of payroll tax reductions may be small.[9] Only the earned income tax credit would accrue to the worker.

A point highlighted by Liebman (1998) and Chetty and Saez (2009) is that the salience of taxation may be important for the responsiveness to tax changes. Riksrevisionen (2009) shows that only 40 percent of respondents were aware of the earned income tax credit in 2009. Since retirement regards the decision to leave the labor force and the earned income tax credit is deducted automatically on the monthly paycheck, however, older workers may adjust their behavior to the tax credit without explicit knowledge of its existence or structure. Furthermore, there is evidence that indirect taxes are less salient than direct taxes, which implies that the payroll tax credit may have a smaller impact than the earned income tax credit.[10]

It should also be noted that workers above age 65 are not eligible for the social programs financed by payroll taxes. In that sense, the payroll tax reform could be motivated by "fairness" rather than by promoting work. For these reasons, it is worth to also consider the case in which the statutory incidence determines the economic incidence of taxation. If only the earned income tax credit accrues to the worker, the individual budget constraint would be given by:

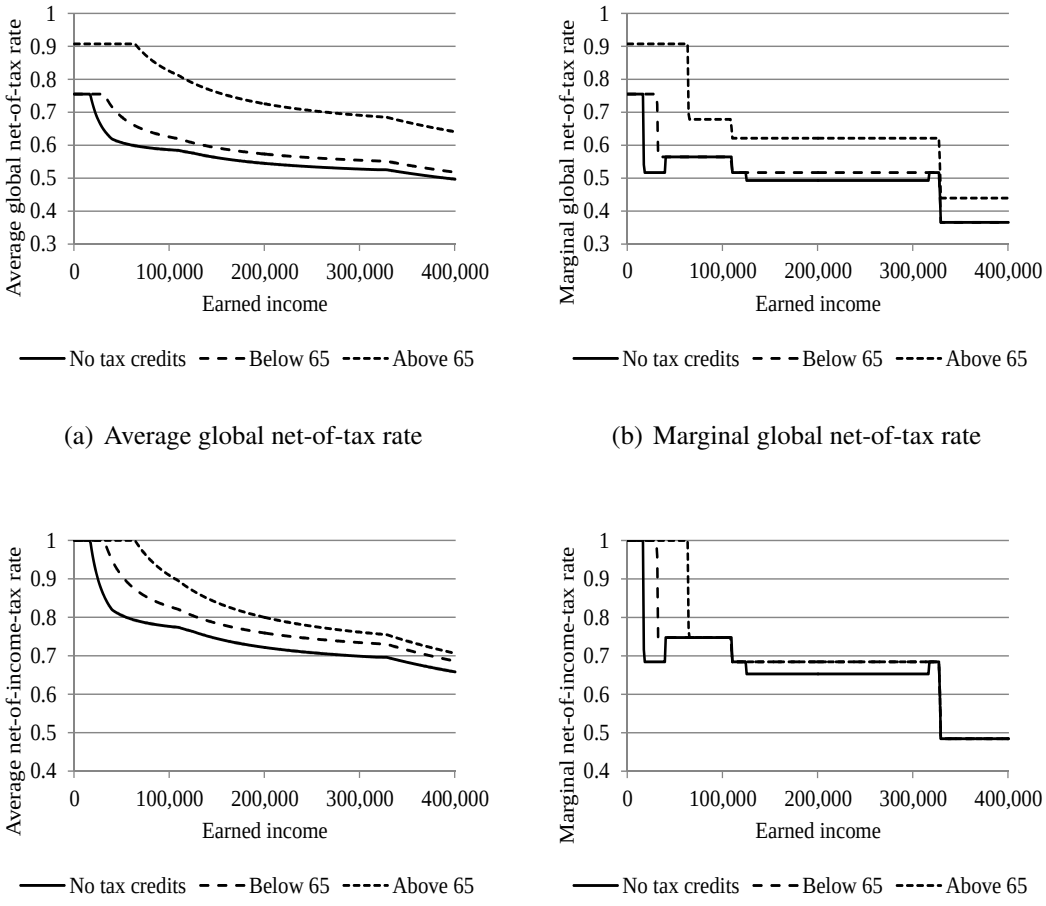
$$c = \tau^I z + R^I, \tag{2}$$

where the taxable wage z is unaffected by the reform.

Figure 4 shows how the age-targeted tax credits altered the average and marginal net-of-tax rates of individuals below and above age 65 in 2007. The upper panels present the global net-of-tax rate, taking both the payroll tax credit and the earned income tax credits into account, as in equation (1). The lower panels present the net-of-income-tax rate, only

[9] See, e.g., Bennmarker, Mellander and Öckert (2009) and Huttunen, Pirttilä and Uusitalo (2010).
[10] See, e.g., the discussion in Pirttilä and Selin (2011).

taking the earned income tax credit into account, as in equation (2). At the extensive margin, where the individual decides whether to work or not, the predictions of the age-targeted tax credits are clear. Since the average net-of-tax rates in Figure 4(a) and 4(c) are higher for workers above compared to below age 65 throughout the earnings distribution, the tax credits unambiguously increased the relative incentives for employment among older compared to younger workers.



(a) Average global net-of-tax rate

(b) Marginal global net-of-tax rate

(c) Average net-of-income-tax rate

(d) Marginal net-of-income-tax rate

Figure 4: The average and marginal global net-of-tax rate and net-of-income-tax rates in 2007, without tax credits and with tax credits above and below age 65

At the intensive margin, the effects of the tax credits on labor supply are ambiguous. A reduction in the marginal tax rate affects labor supply through a positive substitution effect, due to the higher relative price of leisure, and a negative income effect, due to the

increase in the net wage, given that leisure is a normal good. The substitution effect typically dominates the income effect. In addition to the price effect, there is an additional income effect from the reduction in the average tax rate, affecting labor supply in a negative direction. In the upper panels of *Figure 4*, including both the earned income tax credit and the payroll tax credit, the positive substitution effect from the higher marginal net-of-tax rate and the negative income effect from the higher average net-of-tax rate for workers above age 65 implies that the effect on labor supply at the intensive margin is undetermined. In the lower panels, where only the earned income tax credit is accounted for, the marginal net-of-tax rate is the same beyond the phase-in region of the credit whereas the average net-of-tax rate is higher for workers above age 65. In this region, the substitution effect is the same but the income effect is larger for older compared to younger workers, resulting in unambiguously smaller incentives for work in the older age group.

4 Empirical strategy

The aim of the empirical analysis is to examine to what extent the two labor tax credits for workers above age 65 introduced in 2007 affected labor market outcomes in the targeted group. Since the earned income tax credit and the payroll tax credit were introduced simultaneously and applied to the same group of workers, the main analysis studies the joint impact of the two credits. To isolate the effect of the policy changes from other confounding factors that may affect retirement, I exploit a feature inherent in the design of the tax policies. Eligibility for the age-targeted tax credits was determined by the age at the beginning of the tax year, which created a discontinuity in labor income tax rates that depended on the date of the 65th birthday.[11] Individuals who turned 65 just before the new year were eligible for the tax credits from 1 January while individuals who turned 65 just after the new year were eligible for the tax credits one year later. I use this discontinuity in labor taxation to identify the effect of the age-targeted tax credits on labor market outcomes in the year immediately following the 65th birthday.

Individuals who turn 65 on different sides of the new year may differ in terms of labor

[11] The Swedish tax year follows the calendar year.

market outcomes even in absence of the age-targeted tax credits. The treatment group is slightly older than the control group, which reduces labor force attachment at a given point in time. As discussed in Section 2.2, the new public pension system is also slowly phased in by an equal amount for each successive cohort. Furthermore, the cutoff for school start is defined by calendar year in Sweden. Fredriksson and Öckert (2009) show that individuals born early in the year, who start school at an older age, perform better in terms of long-run labor market outcomes than individuals born late in the year. To the extent that relative labor market outcomes of individuals who turn 65 on different sides of the new year are constant across cohorts, however, such differences can be controlled for using a difference-in-differences approach.

I estimate a model which compares the difference in labor market outcomes of individuals who turn 65 on different sides of the new year before and after the implementation of the tax credits:

$$y_{it} = \alpha + \gamma Reform_{it} + \beta' X_{it} + \lambda_a + \lambda_t + \varepsilon_{it}, \tag{3}$$

where y_{it} is the labor market outcome of individual i in year t, X_{it} is a vector of individual characteristics, λ_a is a set of indicator variables for the individual's age in months at the beginning of the tax year, λ_t is a set of indicator variables for the year in which the outcome is measured and ε_{it} is the error term. The variable $Reform_{it}$ is an indicator variable that takes the value one if the individual is aged 65 or above at the beginning of the tax year and the year is 2007 or later, when the age-targeted tax credits were in place. The coefficient γ captures the treatment effect of the age-targeted tax credits. The fact that the control group will receive the tax credits one year later may impact their labor market outcomes during the year of analysis as well, for example by remaining employed until becoming eligible. Such behavior would attenuate the estimated effects of the tax credits. The treatment effect can thus be interpreted as the effect of receiving the age-targeted tax credits one year earlier.

The identifying assumption is that the relative labor market outcomes of the treatment and the control group would have remained constant in absence of the reform. To assess

this assumption, I perform a t-test for the presence of a linear time trend in the pre-reform period. I also estimate the models:

$$y_{it} = \alpha + \sum_{t=s}^{S} \gamma_t \delta_{treat} \times \lambda_t + \beta' X_{it} + \lambda_a + \lambda_t + \varepsilon_{it}, \tag{4}$$

$$y_{it} = \alpha + \sum_{a=m}^{M} \gamma_a \delta_{post} \times \lambda_a + \beta' X_{it} + \lambda_a + \lambda_t + \varepsilon_{it}, \tag{5}$$

where the second term in equation (4) are treatment×year interactions that take the value one if the individual belongs to the treatment group and the year is equal to t, and the second term in equation (5) are post×age interactions that take the value one if the age in months at the beginning of the tax year is a and the year is 2007 or later. In these models, there should be no effect of the reform in the years before 2007 and for ages below 65. The effect should appear where eligibility for the tax credits truly begins.

One threat to identification is that other reforms have affected the same cohorts as the age-targeted tax credits. The large compulsory school reform analyzed by, e.g., Meghir and Palme (2005) primarily affected cohorts born in the end of the 1940s onwards. The youngest cohort included in this study were born in 1944, and Holmlund (2007) shows that less than 5 percent of this cohort was affected by the compulsory school reform. Also the public pension system was reformed during the period under study. The first cohort in the new pension system was aged 65 at the beginning of 2003, however, several years before the introduction of the tax credits.

If the error terms of individuals in different groups are correlated, standard errors could be biased. Common shocks that create dependence of individuals within a group could appear for a number of reasons. It might be difficult to imagine local labor market shocks that affect individuals only a few months apart in age differently, but cohort based reforms earlier in life could have lasting differential impacts on the treatment and control groups. I handle this issue by aggregating the analysis to the group level using the two-step approach suggested by Donald and Lang (2007).[12] In the first step, I construct

[12] A similar strategy is to cluster the standard errors at the group level, but since this method requires a large number of clusters, it is not feasible here.

covariate adjusted group-year effects, μ_{gt}, by estimating:

$$y_{igt} = \mu_{gt} + \beta' X_{it} + \lambda_a + v_{igt}, \tag{6}$$

where y_{igt} is the outcome variable, X_{it} are individual characteristics, λ_a are indicator variables for the age in months at the beginning of the tax year and v_{igt} is the error term. In the second step, the estimated group year effects, $\hat{\mu}_{gt}$, are regressed on the variables that vary only at the group and year level using the equation:

$$\hat{\mu}_{gt} = \alpha + \gamma Reform_{gt} + \lambda_t + u_{gt}, \tag{7}$$

where $Reform_{gt}$ is the reform indicator and λ_t are year dummies.

5 Data

I use register-based data compiled and maintained by Statistics Sweden. The Longitudinal Database on Education, Income and Employment (LOUISE) provides demographic and socioeconomic information, the Income and Tax Register (IoT) provides individual income tax records, and the Register-Based Labor Market Statistics (RAMS) provides records of employment spells. The estimation sample is a cross-section of individuals who turned 65 during a certain window around the new year between 2001 and 2009.[13] Historical records are used to construct individual baseline characteristics. Since the tax credits were introduced in 2007 and the last observation year is 2009, events that occurred at least three years earlier are exogenous to the policies for all years. To limit transitory fluctuations, I use the three to five years before the year of analysis as the "baseline years" for constructing covariates. These are the years when individuals with birthday before the new year turned 61–63 and individuals with birthday after the new year turned 60–62. The data cover the period 1996 to 2009.

I define previous earnings as the maximum annual earnings during the baseline years, which can be thought of as "potential earnings" if the individual would continue work-

[13] The data cover the entire Swedish population aged 16–64 before 2001 and aged 16–74 during 2001–2009. Because of the age restriction before 2001, the first year of analysis is 2001.

ing after age 65.[14] To exclude individuals who exited the labor force early, the estimation sample is limited to individuals with previous earnings above the 2007 tax liability threshold.[15] This sample restriction is assessed below. Education level is determined by the maximum level during the period. A variable of previous sickness indicates that the individual received sickness or disability benefits from the Social Insurance Agency during the baseline years.[16] Using household identifiers, I identify the spouse in the baseline years and record whether the spouse was younger, older or if there was no spouse.[17] Self-employment status, immigrant status and the municipality and county of residence is determined by the most common record during the baseline years.

The year and month of birth are used to define eligibility for the age-targeted tax credits. The day of birth is not available in the data. The analysis requires that the window of birth months around the new year is determined. The most restrictive approach is to compare individuals turning 65 in December to individuals turning 65 in January, who are only one month apart in age but face different labor tax rates. Expanding the window is a trade-off between increasing the sample size, which improves efficiency, and increasing the age difference between the treatment and control group, which reduces comparability.

The first three columns in *Table 1* present the raw differences in baseline characteristics between the treatment and the control group for samples of individuals who turned 65 within one to three months around the new year during 2001–2009. The treatment group is slightly less educated than the control group, which can be expected since the treatment group belongs to an older cohort and education has expanded over time. There are also fewer immigrants in the treatment group, which might be explained by anecdotal evidence that immigrants with an unknown birthday are recorded on 1 January.[18] Individuals in the treatment group are also more likely to have an older spouse. Since they are born late in the year, while individuals in the control group are born early, the treatment

[14] I use maximum rather than average earnings to limit the impact of low annual earnings due to individuals exiting the labor force.

[15] The 2007 tax liability threshold was SEK 17,100 ($ 2,400).

[16] Since the employer period is two weeks this includes individuals absent for more than two weeks.

[17] Some of the individuals recorded as having no spouse may, however, be co-habiting.

[18] Since the recorded birthday is used for tax purposes, this should not be a problem. Furthermore, the share of immigrants is low.

group is more likely to be younger than their spouse when marrying someone in the same birth cohort. The differences in previous sickness, self-employment status and previous earnings are small and becomes insignificant on a five percent level when the window is narrowed to 1 or 2 months around the new year.

Table 1: Raw differences between the treatment and control groups and estimation of the reform indicator on covariates for different sample selections

	Raw difference treatment–controls			Estimation of reform indicator on covariates		
Variables	Dec-Jan	Nov-Feb	Oct-Mar	Dec-Jan	Nov-Feb	Oct-Mar
	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.003	-0.003	-0.001	-0.001	0.001	0.001
	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
High School	-0.001	-0.002	-0.004**	-0.002	0.000	0.001
	(0.003)	0.002	(0.002)	(0.002)	(0.001)	(0.001)
College	-0.013***	-0.016***	-0.016***	-0.007***	-0.002	-0.001
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Immigrant	-0.006***	-0.005***	-0.003**	0.003	0.003*	0.003**
	(0.002)	(0.001)	(0.001)	(0.003)	(0.002)	(0.001)
Previously sick	0.000	-0.004*	-0.004**	0.000	-0.001	-0.001
	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Older spouse	0.006***	0.009***	0.007***	0.002	0.000	0.001
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Younger spouse	-0.009***	-0.011***	-0.008***	0.002	0.002	0.002
	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Self-employed	0.002	0.002	0.003***	-0.001	-0.002	-0.000
	0.002	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)
Previous earnings	-2,270*	-1,566*	-2,761***	0.000	0.000	0.000
	(1,166)	(899)	(713)	(0.001)	(0.000)	(0.000)
County dummies				Yes	Yes	Yes
Year dummies				Yes	Yes	Yes
Age dummies				Yes	Yes	Yes
Observations				92,893	181,184	281,944
R-squared				0.617	0.614	0.607
F-test				1.465	0.994	1.097
Prob > F				0.0508	0.474	0.329

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Treatment and control groups consist of individuals turning 65 in Oct–Dec and Jan–Mar, respectively, 2001–2009, with previous earnings above 17,100 (2007 SEK). Excluded education cat.: less than high school, excluded marital status: no spouse.

The difference-in-differences strategy allows the treatment and control groups to be different, as long as the characteristics do not change at the same time as the reform was implemented. The last three columns in *Table 1* report whether the individual characteristics of the treatment group change discontinuously at the time of the reform. The table

presents the results from the model:

$$Reform_{it} = \alpha + \beta' X_{it} + \lambda_a + \lambda_t + \varepsilon_{it}, \tag{8}$$

which captures how the reform indicator $Reform_{it}$ depends on individual characteristics X_{it} when controlling for age in months and time effects, as in the main analysis. An F-test tests the joint restriction of all coefficients on the variables in X_{it} being zero.

For the sample of individuals with birthday in December and January, the F-statistic suggests that I can reject the joint restriction of all coefficients being zero on a five percent significance level. For such a limited sample, the share of college educated decreases discontinuously in the treatment group at the time of the reform. A smaller share of college educated in the treatment group is likely to attenuate any effects, since educated workers are more likely to remain employed. The difference is small and disappears when expanding the sample. For the sample of individuals born between November and February and between October and March, the F-statistics suggest that I cannot reject the joint restriction of all coefficients on the variables in X_{it} being zero, which is reassuring. To keep the treatment and control groups as similar as possible, I use the sample of individuals with birthday from November to February in the estimation, i.e., a window of two months around the new year. Summary statistics for this sample are presented in *Table A-1* in the Appendix.

In terms of outcome variables, there is no information about hours or wages for workers above age 64 in the Swedish register data. There is, however, information about annual taxable labor earnings, which is the sum of labor earnings from formal employment and self-employment net of certain costs for acquiring the income. There are also records of the number of remunerated months reported by employers. Given the theoretical predictions, extensive margin responses are the most interesting. Theory predicts an unambiguously positive employment effect of the two tax credits. The first outcome variable is employment, defined as having annual taxable labor earnings above one income

base amount (SEK 45,900 or about $\$6,600$ in 2007).[19] Since individuals in the control group turn 65 in January or February during the year in which the outcomes are measured, a positive cutoff helps capturing employment past age 65. In a sensitivity analysis, other cutoffs for employment are being used, as well as extensive margin responses based on the number of remunerated months.

To make use of the data at hand, I also construct three outcome variables capturing responses at the extensive and intensive margins combined. Although the tax credits are predicted to increase labor supply at the extensive margin, negative income effects may decrease labor supply at the intensive margin, implying an undetermined total effect. The second outcome variable is the annual taxable labor earnings, including zero records. The third outcome variable is the annual taxable labor earnings as a share of previous earnings, defined above. The difference between the second and third outcome variable is merely an issue about functional form. Whereas the second outcome variable captures the effect on earnings linearly, the third outcome variable captures the effect on the extent of work in relation to the "potential" extent of work. This may be closer to capturing the effect on hours worked. Finally, the fourth outcome variable is the number of remunerated months. This outcome variable is a valuable complement since it makes use of another source of data, originating from employer records.

Table 2 shows the averages of the outcome variables in the treatment and control groups between 2001 and 2006, before the tax credits were in place. The outcome variables are measured on a tax year basis. Since the treatment group is slightly older than the control group during the year in which the outcome is measured, the treatment group has a lower employment rate, lower labor earnings, earns a lower share of previous earnings and has fewer remunerated months than the control group.

As explained above, the sample is limited to individuals with previous earnings above the 2007 tax liability threshold. This affects the external validity of the results, since the conclusions drawn from the empirical analysis can only be applied to this particular group. As is shown below, however, more than two thirds of the individuals are included

[19] The income base amount is determined by the government each year and is used for calculations in the public pension system. It closely follows the development of income in the economy.

Table 2: Summary statistics, outcome variables

	Treatment Group (1)	Control Group (2)	Difference (3)
Employment	0.226	0.295	-0.070***
	(0.002)	(0.002)	(0.003)
Taxable labor earnings	45,183	54,900	-9,717***
	(512)	(474)	(697)
Share of previous earnings	0.184	0.222	-0.038***
	(0.002)	(0.002)	(0.003)
Remunerated months	3.844	4.318	-0.475***
	(0.024)	(0.023)	(0.033)
Observations	51,019	55,565	

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Treatment and control groups consist of individuals turning 65 in Nov–Dec and Jan–Feb, respectively, 2001–2009, with previous earnings above 17,100 (2007 SEK). Employed if earnings>1 income base amount.

in the estimation sample, and the results thus apply to a large share of the population. The motivation for the sample restriction is that individuals with very low earnings in all years three to five years before turning 65 are unlikely to be affected by financial incentives for continued work after age 65. They may be homemakers or have exited the labor force early due to, for example, health reasons. To impact the labor supply of these workers, reforms to systems that are more relevant for early retirement, such as the disability insurance or occupational insurance schemes, are likely to be more effective.

To make sure that the sample restriction does not drive any results, I study if the probability of being included in the estimation sample is continuous at the cutoff. I estimate the following model on the full population:

$$Reform_{it} = \alpha + \beta Included_{it} + \lambda_a + \lambda_t + \varepsilon_{it}, \tag{9}$$

which captures how the reform indicator depends on the probability of being included in the sample. The results, presented in the first column of *Table A-2* in the Appendix, show that the probability of being included in the estimation sample does not change discontinuously at the cutoff, which is reassuring. The second column of *Table A-2* shows the effect of covariates on the probability of being included in the sample. The value of the constant implies that on average 71 percent of the cohort are included. Women, immigrants and individuals who were previously sick are less likely to be included in

the sample, whereas educated workers, self-employed and workers with a spouse are more likely to be included. I also estimate the main model specified in equation (3) for the excluded sample. The results, presented in *Table A-3* in the Appendix, show that the reform effect is insignificant and close to zero, which suggests that any findings for the estimation sample will not be counteracted by a differential effect for the sample of individuals excluded from the analysis because of their labor market history.

6 Results

This section presents the results from the empirical analysis. First, I present the main estimation results of the impact of the age-targeted labor tax credits on labor market outcomes, along with a variety of robustness checks. Thereafter, I study heterogeneous effects for different groups of the population and try to distinguish between potential mechanisms. Next, I make an attempt to assess the relative importance of the two types of tax credits. Finally, I translate the estimation results into elasticities and perform rough calculations of public finance implications, given the behavioral responses found in the analysis.

6.1 Main results

Table 3 presents the main results from estimating equation (3) for the sample of individuals who turned 65 from November to February during 2001–2009 and had annual earnings above the 2007 tax liability threshold three to five years earlier. Each column presents the results from a separate regression for each outcome variable. Column (1) shows that the age-targeted tax credits increased the probability of employment during the year immediately following the 65th birthday by 1.5 percentage points among individuals with previous earnings above 17,100 (2007 SEK). Relating this to the average employment rate in the sample, presented at the end of the table, implies an employment effect of 4.9 percent. The estimated effect on taxable labor earnings in column (2) is positive but not significantly different from zero. For taxable labor earnings as a share of previous earnings, presented in column (3), however, there is a positive and significant effect of 1.8 percentage points or about 7.6 percent. That the impact on earnings as a share

of previous earnings is significant, while the effect on labor earnings is not, might be due to the latter variable being too volatile for capturing labor market responses. Finally, the results for the number of remunerated months in column (4) suggest a significant increase of 0.133 months, or 2.9 percent, due to the age-targeted tax credits.

Table 3: The effect of the age-targeted tax credits on labor market outcomes

Variables	Employment (1)	Taxable labor earnings (2)	Share of previous earnings (3)	Remunerated months (4)
Reform	0.015***	1,518	0.018***	0.133***
	(0.004)	(1,335)	(0.004)	(0.051)
Female	-0.069***	-27,134***	-0.035***	-0.439***
	(0.002)	(718)	(0.003)	(0.029)
High School	0.027***	8,910***	0.022***	0.396***
	(0.002)	(538)	(0.002)	(0.029)
College	0.138***	56,949***	0.099***	1.693***
	(0.003)	(948)	(0.003)	(0.034)
Immigrant	-0.003	2,815**	0.017***	-0.246***
	(0.003)	(1,188)	(0.004)	(0.040)
Self-employed	0.114***	14,563***	0.206***	2.843***
	(0.005)	(1,495)	(0.007)	(0.055)
Previously sick	-0.129***	-34,974***	-0.090***	-1.458***
	(0.002)	(529)	(0.002)	(0.026)
Older spouse	-0.063***	-12,465***	-0.058***	-0.582***
	(0.003)	(722)	(0.003)	(0.032)
Younger spouse	-0.004	1,358*	-0.017***	0.066**
	(0.003)	(812)	(0.003)	(0.032)
Constant	0.282***	62,577***	0.207***	3.920***
	(0.005)	(1,409)	(0.006)	(0.062)
County dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Age dummies	Yes	Yes	Yes	Yes
R-squared	0.086	0.096	0.055	0.077
Observations	181,184	181,184	181,184	181,184
p-val parallel trends test	0.327	0.192	0.639	0.919
Mean of dep. variable	0.306	64,382	0.242	4.541
Effect in percent	0.049	0.024	0.076	0.029

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Individuals turning 65 Nov–Feb 2001–2009 with previous earnings above 17,100 (2007 SEK). Employed if earnings>1 income base amount.

As discussed in Section 4, the underlying assumption in the difference-in-dif- ferences approach is that the relative labor market outcomes of the treatment and control groups would have remained constant in absence of the reform. The third to last row of *Table 3*

presents the p-value from the t-test of the presence of a linear time trend in the pre-reform period, suggesting that I cannot reject the parallel trends assumption. *Table 4* presents the estimation results for the model with unrestricted treatment×year interactions, specified by equation (4). The data cover the period 2001–2009 and the excluded years for the interaction terms are 2001–2003. The results show no significant effects of the tax credits in the pre-reform period, on a five percent significance level, which also supports the parallel trends assumption. The significant effects show up from 2007, when the age-targeted tax credits were implemented, and can mainly be seen in 2008 and 2009. The late response could be due to an increased awareness of the tax credits over time or by the expansion of the earned income tax credit.

Table 4: The effect of the age-targeted tax credits on labor market outcomes, estimation with treatment×year interactions

Variables	Employment (1)	Taxable labor earnings (2)	Share of previous earnings (3)	Remunerated months (4)
Treatment × Year 2004	0.005	-403	-0.001	0.003
	(0.007)	(2,046)	(0.007)	(0.090)
Treatment × Year 2005	0.010	780	0.009	0.035
	(0.007)	(1,802)	(0.007)	(0.089)
Treatment × Year 2006	-0.008	-1,011	-0.003	0.034
	(0.008)	(1,998)	(0.008)	(0.091)
Treatment × Year 2007	0.007	2,434	0.018***	0.043
	(0.007)	(2,373)	(0.007)	(0.086)
Treatment × Year 2008	0.018***	-191	0.020***	0.191**
	(0.007)	(2,102)	(0.008)	(0.083)
Treatment × Year 2009	0.023***	2,046	0.020***	0.189**
	(0.007)	(2,084)	(0.007)	(0.081)
R-squared	0.366	0.259	0.258	0.448
Observations	181,184	181,184	181,184	181,184

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Individuals turning 65 Nov–Feb 2001–2009 with previous earnings above 17,100 (2007 SEK). Employed if earnings>1 income base amount. Excluded interactions: 2001–2003. Includes the controls in Table *Table 3*.

Table 5 presents the estimation results for the model with unrestricted post×age interactions, specified by equation (5). The sample includes individuals who turned 65 from October to March during 2001–2009 and the excluded category for the interaction term is turning 65 in March. The effect on employment clearly appears for those turning 65 in December and earlier, where eligibility for the age-targeted tax credits begins. There is

also a shift around the new year for earnings as a share of previous earnings and the number of remunerated months, although not all coefficients are significant. The estimates for taxable labor earnings are volatile, which might explain why there were no significant effects for this variable in the main analysis. For the other outcome variables, the results support the assumption of parallel trends and suggest that it is in fact the effect of the tax credits that is being captured in the analysis.

Table 5: The effect of the age-targeted tax credits on labor market outcomes, estimation with post×age interactions

Variables	Employment (1)	Taxable labor earnings (2)	Share of previous earnings (3)	Remunerated months (4)
Post × 65 in February	0.004	-984	-0.004	0.034
	(0.006)	(1,805)	(0.006)	(0.067)
Post × 65 in January	0.007	-3,372*	-0.007	-0.057
	(0.006)	(1,788)	(0.005)	(0.067)
Post × 65 in December	0.017***	-645	0.010*	0.083
	(0.006)	(1,979)	(0.006)	(0.068)
Post × 65 in November	0.023***	-720	0.016**	0.161**
	(0.006)	(1,858)	(0.006)	(0.070)
Post × 65 in October	0.012**	-3,421*	-0.000	0.103
	(0.006)	(1,797)	(0.006)	(0.068)
R-squared	0.384	0.267	0.270	0.453
Observations	281,944	281,944	281,944	281,944

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Individuals turning 65 Oct–Mar 2001–2009 with previous earnings above 17,100 (2007 SEK). Employed if earnings>1 income base amount. Excluded interaction: 65 in March. Includes the controls in Table *Table 3*.

The results from the two-step approach suggested by Donald and Lang (2007), given by equations (6) and (7), are presented in *Table A-4* in the Appendix. All effects are still significant on a ten percent level, which is reassuring. *Table A-5* in the Appendix shows that the results do not depend on the inclusion of control variables. Finally, to make sure that the results are robust to other sample selections than individuals who turned 65 from November to February, *Table A-6* in the Appendix presents the estimated coefficient on the reform variable for samples of individuals with birthday within 1–3 months around the new year. The pattern of the results is the same also for other sample selections.

The estimation results are not sensitive to the cutoff value for employment. *Table A-7* in the Appendix presents the results for different earnings cutoffs and shows that the

results are similar for earnings above 0 to 1.5 income base amounts, which is a reasonable range for an employment cutoff. For earnings above 2 income base amounts, about 90,000 SEK in 2007 ($ 12,900), there is no significant effect of the tax credits and the pattern is the same also for higher cutoff values. This is in accordance with the fact that there was no significant effect on taxable earnings in the main estimation. *Table A-8* presents the results for the probability of working more than a certain number of months. The effect is largest for the probability of working more than zero months, and is the same, around 1 percentage point, for the probability of working more than 3, 6 or 9 months. Taken together, the results suggest that the age-targeted tax credits affected the probability of being employed at earnings levels that imply less than full time work.

To sum up, the results suggest that the age-targeted labor tax credits increased employment in the year following the 65th birthday by 1.5 percentage points or about 5 percent, increased earnings as a share of previous earnings by 1.9 percentage point or almost 8 percent and increased the number of remunerated months by 0.137 or about 3 percent for individuals with annual earnings above the 2007 tax liability threshold three to five years earlier. The specification tests support the identifying assumption of parallel trends in the outcome variables, and the results are shown to be robust to a variety of robustness checks.

6.2 Heterogeneous effects

To better understand the origin of the positive effects found in the main analysis, this section provides an analysis of heterogeneous responses to the tax credits. *Table 6* presents the results from separate estimations of equation (3) for different groups of the population. The first column presents the number of observations in each group along with the F-statistic from testing whether individual characteristics change discontinuously at the time of the reform within the group, as specified by equation (8). The test is performed for the covariates in X_{it} excluding the variable that defines the group, and for none of the groups can the joint restriction of all coefficients being zero be rejected, which is reassuring.

Labor supply studies of prime-aged workers typically find that responses are larger

Table 6: Heterogeneous effects of the age-targeted tax credits on labor market outcomes

Group	Obs Prob>F	Employment	Taxable labor earnings	Share of previous earnings	Remunerated months
	(1)	(2)	(3)	(4)	(5)
A. Gender					
Men	93,048	0.024***	2,962	0.030***	0.190***
	0.878	(0.006)	(2,274)	(0.007)	(0.073)
Women	88,136	0.005	-368	0.006	0.066
	0.166	(0.006)	(1,299)	(0.005)	(0.072)
B. Education					
Less than high school	61,498	0.006	-114	0.016**	0.100
	0.373	(0.007)	(1,588)	(0.007)	(0.088)
High school	72,492	0.016**	1,196	0.014**	0.079
	0.366	(0.007)	(1,653)	(0.007)	(0.081)
College	47,194	0.021**	4,903	0.025**	0.192*
	0.884	(0.009)	(3,782)	(0.010)	(0.103)
C. Health					
Previously sick	71,986	0.008	-97	0.015**	0.122
	0.403	(0.006)	(1,347)	(0.006)	(0.078)
Not previously sick	109,198	0.020***	2,561	0.021***	0.142**
	0.303	(0.006)	(2,009)	(0.006)	(0.068)
D. Age of spouse					
Older spouse	52,969	0.010	3,723*	0.013*	0.030
	0.246	(0.007)	(2,072)	(0.007)	(0.092)
Younger spouse	68,252	0.028***	2,360	0.033***	0.227***
	0.723	(0.007)	(2,557)	(0.007)	(0.085)
No spouse	59,963	0.006	-882	0.008	0.117
	0.339	(0.007)	(2,100)	(0.008)	(0.089)
E. Type of employment					
Regular employee	169,050	0.011**	711	0.012***	0.140***
	0.176	(0.004)	(1,355)	(0.004)	(0.053)
Self-employed	12,134	0.066***	12,499*	0.100***	0.064
	0.683	(0.018)	(6,446)	(0.027)	(0.212)

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Individuals turning 65 Nov–Feb 2001–2009 with previous earnings above 17,100 (2007 SEK). Employed if earnings>1 income base amount. Separate estimations for different population groups. Includes the controls in Table *Table 3*.

among women than men. Male labor force participation is in general high and most men work full time, which gives little room for behavioral responses. Interestingly, panel A shows that the effects of the age-targeted tax credits on labor market outcomes can be attributed entirely to the male subsample. The results suggest that the tax credits increased the probability of employment by 2.4 percentage points, earnings as a share of previous earnings by 3 percentage points and the number of remunerated months by 0.191 for men, while none of the estimates are significantly different from zero for women. For workers at the margin of retirement, men thus seem to be more responsive than women to changes in financial incentives.

Panel B indicates that the effects increase with education, which could be due to institutional factors or preferences for work. A recent report to the Swedish government (SOU 2012:28) shows that low income earners who qualify for guaranteed pension at age 65 have little to gain from working past this age, since pension benefits are unaffected by delayed retirement.[20] In this group, women are overrepresented. If individuals have adverse financial incentives for work to begin with, the age-targeted tax credits are unlikely to impact their retirement decision. In addition, since eligibility for unemployment benefits ceases at age 65, the only option for unemployed workers above this age is to retire, and the risk of unemployment is higher among low-educated workers. Occupational agreements may also be more binding for this type of workers, affecting the flexibility for continued work, and social conventions about retirement ages may be particularly strong in certain workplaces. In terms of preferences, individuals who dislike their job or have physically demanding jobs that are hard to pursue at older ages are likely to be less responsive to reforms, which is also linked to education.

Relatedly, individuals in bad health incur a larger disutility of labor and may be less responsive to financial incentives for delayed retirement. Panel C divides the sample according to previous sickness history, where sickness is defined as having collected sickness or disability benefits from the Social Insurance Agency at some point during the baseline years, three to five years earlier. The responses to the age-targeted tax cred-

[20] Individuals who also qualify for housing benefits or other means-tested transfers have even smaller incentives for continued work, since benefits are reduced against income.

its are indeed concentrated among the healthier individuals. Several studies have also documented a strong correlation in the timing of retirement between spouses, suggesting an additional value of joint retirement.[21] Panel D separates the sample by the age of the spouse during the baseline years, which is a proxy for the labor market status of the spouse that is exogenous to the reform. Interestingly, the responses to the reform can be almost completely attributed to workers with a younger spouse.

Self-employed are particularly autonomous in their labor supply decision and are little constrained by institutional factors. Panel E presents separate results for self-employed and regular employees, where self-employment is defined based on the main type of employment during the baseline years. The results are striking, suggesting an effect on employment for self-employed of 6.8 percentage points, compared to 1.1 percentage point for regular employees. The effect on earnings as a share of previous earnings is 10 percentage points for self-employed compared to 1.2 percentage points for regular employees. Even the coefficient on labor earnings is large and significant for this group of workers, while there is no significant effect on the number of remunerated months. The reported taxable labor earnings of self-employed may, however, be a result of tax planning rather than reflecting labor supply.

The heterogeneity analysis showed that the responses to the age-targeted tax credits were largest among men, high educated, workers in good health, workers with a younger spouse and self-employed. Since men are healthier, more likely to have a younger spouse and more likely to be self-employed, the question is if these results are due to men in general responding more to the age-targeted tax credits, or if men respond more because their characteristics affect the responsiveness. To shed further light on potential mechanisms, *Table 7* and *Table 8* present the results from the heterogeneity analysis separately for men and women. The number of observations in the first column of the two tables indicates that some groups are very small. Individuals in these groups may of course be different in many respects. The F-statistics in the first column suggest that we cannot reject the joint restriction of all coefficients on the covariates being zero, however, except for women

[21] See, e.g., Hurd (1990), Baker (2002) and Schirle (2008). Zweimüller et al. (1996) find that husbands are sensitive to changes in their wives incentives but not vice versa.

who had not been previously sick. For all other groups, the characteristics did not change discontinuously at the time of the reform.

Table 7: Heterogeneous effects of the age-targeted tax credits on labor market outcomes, men

Group	Obs Prob>F	Employ-ment	Taxable labor earnings	Share of previous earnings	Remune-rated months
	(1)	(2)	(3)	(4)	(5)
A. Education					
Less than high school	34,426	0.011	1,499	0.029***	0.142
	0.664	(0.010)	(2,451)	(0.010)	(0.120)
High school	36,343	0.033***	2,105	0.027***	0.224*
	0.609	(0.010)	(2,849)	(0.010)	(0.117)
College	22,279	0.021	7,897	0.035**	0.114
	0.983	(0.013)	(7,104)	(0.018)	(0.152)
B. Health					
Previously sick	31,898	0.025**	2,872	0.031***	0.253**
	0.709	(0.010)	(2,385)	(0.011)	(0.121)
Not previously sick	61,150	0.025***	3,097	0.030***	0.161*
	0.730	(0.008)	(3,190)	(0.009)	(0.091)
C. Age of spouse					
Older spouse	11,645	0.053***	17,159**	0.060***	0.303
	0.505	(0.017)	(7,129)	(0.021)	(0.205)
Younger spouse	54,997	0.025***	2,081	0.033***	0.181*
	0.897	(0.008)	(3,072)	(0.009)	(0.096)
No spouse	26,406	0.012	-1,168	0.011	0.185
	0.218	(0.011)	(3,706)	(0.014)	(0.135)
D. Type of employment					
Regular employee	84,560	0.021***	1,659	0.021***	0.186**
	0.644	(0.006)	(2,349)	(0.007)	(0.076)
Self-employed	8,488	0.055**	16,329*	0.121***	0.274
	0.348	(0.022)	(8,727)	(0.033)	(0.252)

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Men turning 65 Nov–Feb 2001–2009 with previous earnings above 17,100 (2007 SEK). Employed if earnings>1 income base amount. Includes the controls in Table *Table 3*.

The results by education group, presented in panel A of *Table 7*, suggest that the largest responses for men appeared among workers with high school education. The standard errors are large, however, and the coefficients are not significantly different from each other across education groups. For women, presented in panel A of *Table 8*, there are indications of a positive response only among the college educated. Taken together, education may play a role for the responsiveness to the reform. Panel B in the two tables show that no differences remain across group with different histories of sickness absence

once the sample is divided by gender, which suggests that health is not an important determinant of the responsiveness to the tax credits.

Table 8: Heterogeneous effects of the age-targeted tax credits on labor market outcomes, women

Group	Obs Prob>F	Employ-ment	Taxable labor earnings	Share of previous earnings	Remune-rated months
	(1)	(2)	(3)	(4)	(5)
A. Education					
Less than high school	27,072	-0.001	-2,418	-0.001	0.029
	0.542	(0.010)	(1,767)	(0.009)	(0.129)
High school	36,149	-0.001	363	0.002	-0.071
	0.787	(0.009)	(1,634)	(0.008)	(0.111)
College	24,915	0.022*	2,059	0.015	0.264*
	0.903	(0.012)	(3,288)	(0.012)	(0.139)
B. Health					
Previously sick	40,088	-0.004	-2,245	0.004	0.033
	0.355	(0.008)	(1,500)	(0.007)	(0.102)
Not previously sick	48,048	0.013	1,196	0.007	0.096
	0.012	(0.008)	(2,016)	(0.008)	(0.101)
C. Age of spouse					
Older spouse	41,324	-0.002	-548	-0.000	-0.049
	0.175	(0.008)	(1,654)	(0.007)	(0.103)
Younger spouse	13,255	0.035**	893	0.027*	0.420**
	0.243	(0.015)	(3,451)	(0.015)	(0.185)
No spouse	33,557	0.002	-716	0.004	0.051
	0.766	(0.010)	(2,358)	(0.009)	(0.118)
D. Type of employment					
Regular employee	84,490	0.001	-558	0.003	0.087
	0.126	(0.006)	(1,319)	(0.005)	(0.073)
Self-employed	3,646	0.096***	4,901	0.059	-0.353
	0.709	(0.032)	(7,272)	(0.043)	(0.391)

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Women turning 65 Nov–Feb 2001–2009 with previous earnings above 17,100 (2007 SEK). Employed if earnings>1 income base amount. Includes the controls in Table *Table 3*.

Panel C in *Table 7* shows that, for men, the magnitude of the response cannot be significantly separated across ages of the spouse, although men with no spouse tend to respond the least. Among the few women with a younger spouse, presented in panel C of *Table 8*, there are positive and significant effects of the tax credits on employment and the number of remunerated months, which indicates that the value of joint retirement might be important for women. This is of course a small and selected group, however, and the results should be interpreted with some caution.

Finally, panel D in *Table 8* shows that self-employed women responded to the age-targeted tax credits, at least in terms of employment. Panel D in *Table 7* shows that self-employed men responded more than regular employees, but there are substantial effects also for regularly employed men. The fact that low educated and women respond the least to the tax credits, while high educated and self-employed respond the most, is in accordance with the importance of institutions discussed above.

6.3 Separating the effect of the two tax credits

The results presented thus far show the joint effect of the additional earned income tax credit and the payroll tax credit. In this section, I make an attempt to assess the relative contribution of the two types of tax credits by exploiting that the size of the earned income tax credit varies by income and year, whereas the size of the payroll tax credit is constant across years and equal for all workers.

I use the main estimation strategy from the previous sections, but replace the reform dummy with two new variables capturing the size of the earned income tax credit and the payroll tax credit, respectively:

$$y_{it} = \alpha + \gamma_1 \Delta \log(\tau_{it}^I) + \gamma_2 \Delta \log(\tau_{it}^P) + \beta' X_{it} + \lambda_a + \lambda_t + \varepsilon_{it}, \tag{10}$$

where τ_{it}^I is the net-of-income-tax rate on taxable earnings and τ_{it}^P is the net-of-payroll-tax rate on gross earnings. The variable $\Delta \log(\tau_{it}^I)$ is the difference in the natural logarithm of the net-of-income-tax rate that is due to the additional earned income tax credit for workers above age 65. It is constructed using the individual's previous earnings, i.e., the maximum annual earnings three to five years earlier, together with the current year tax rules and can thus be interpreted as the change in potential earnings due to the earned income tax credit. It is positive for workers above age 65 during 2007–2009, and varies across individuals depending on the size of previous earnings and year. The variable $\Delta \log(\tau_{it}^P)$ is the difference in the natural logarithm of the net-of-payroll-tax rate that is due to the payroll tax credit for workers above age 65. It is positive and equal across individuals in the treatment group from 2007.

The difference in the natural logarithm of the net-of-tax rate approximately gives the

percentage increase in net earnings, divided by one hundred. The specification of the two variables allows for an interpretation of the coefficients as the level change in the outcome variable from a one hundred percent increase in the net-of-income-tax rate and the net-of-payroll-tax rate, respectively. The mean of $\Delta \log(\tau_{it}^{I})$ in the treatment group 2007–2009 is 0.056, which implies that the additional earned income tax credit increased potential net earnings by approximately 5.6 percent on average. The variable $\Delta \log(\tau_{it}^{P})$ is 0.137 in the treatment group 2007–2009, which implies that the payroll tax credit increased taxable earnings by approximately 13.7 percent, assuming that the full tax incidence fell on the worker. Combined, the tax credits increased potential net earnings, or the global net-of-tax rate, by approximately 19.3 percent on average. The model captures the differential effects of the two tax credits under the assumption that there is a proportional relationship between the size of the tax reduction and the change in behavior. Comparing γ_1 and γ_2 measures which of the two tax credits was most correlated with the behavioral changes found in the main analysis.

In addition to the control variables included in the main analysis, I add flexible controls for previous earnings. I rank all individuals in the sample according to their previous earnings and construct indicator variables for each percentile of the earnings distribution. High income earners are more likely to work after age 65, and the size of the earned income tax credit is negatively correlated with income. By controlling for previous earnings, the estimates capture the relative behavior of individuals with the same level of previous earnings in the treatment and the control group, who only differ in terms of labor tax rates.

Table 9 presents the results for the three outcome variables for which there was a significant effect in the main analysis. The first three columns show the results for the change in the natural logarithm of the global net-of-tax rate, i.e., the sum of $\Delta \log(\tau_{it}^{I})$ and $\Delta \log(\tau_{it}^{P})$. The last three columns show the results for the separate effects of the two variables. The estimates for the global net-of-tax rate in columns (1) to (3) are positive and significant for all outcome variables and the size of the coefficients are in the same ballpark as those in the main analysis. Using the average change in the global net-of-tax rate of 19.3 percent gives an average effect on employment and earnings as a share of

Table 9: Separate effects of the earned income tax credit and the payroll tax credit on labor market outcomes

Variables	Employ-ment (1)	Share of previous earnings (2)	Remune-rated months (3)	Employ-ment (4)	Share of previous earnings (5)	Remune-rated months (6)
EITC + Payroll tax	0.089***	0.090***	0.532**			
	(0.021)	(0.026)	(0.261)			
EITC				0.256***	-0.028	-1.227
				(0.067)	(0.176)	(0.931)
Payroll tax				-0.001	0.153*	1.487***
				(0.045)	(0.081)	(0.567)
Constant	0.134***	0.213***	2.784***	0.134***	0.213***	2.779***
	(0.010)	(0.013)	(0.132)	(0.010)	(0.013)	(0.132)
R-squared	0.144	0.061	0.101	0.144	0.061	0.101
Observations	181,184	181,184	181,184	181,184	181,184	181,184

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Individuals turning 65 Nov–Feb 2001–2009 with previous earnings above 17,100 (2007 SEK). Employed if earnings>1 income base amount. Controls include indicator variables for education, immigrant, self-employment, previous sickness, spousal status, county, year and age, as in Table *Table 3*, and indicator variables of the percentile of previous earnings.

previous earnings of 1.7 percentage points and on the number of remunerated months of about 0.1. This compares well to the estimates reported in *Table 3*. Separately including the two tax credit variables in columns (4) to (6) shows that the effect on employment is primarily attributed to the earned income tax credit variable, but that the opposite holds for earnings as a share of previous earnings, although only significant at a ten percent level, and the number of remunerated months.

The analysis of the relative importance of the two tax credits thus gives contradicting results for different outcome variables. The results also tend to be sensitive to the inclusion and the specification of control variables. The analysis does therefore not provide any conclusive evidence about the relative contribution of the two types of tax credits. The analysis is, however, challenging since the two tax credits were introduced at the same time and applied to the same group of individuals. The estimation strategy is demanding in terms of the variation required to separate the two effects, and the variation in the size of the tax credits by income and year may not be sufficient for generating robust estimates. Edmark, Liang, Mörk and Selin (2012) use a similar approach to evaluate the Swedish earned income tax credit for workers below age 65, exploiting the variation in local tax rates across municipalities. The authors find a positive effect of the earned

income tax credit but also a positive placebo effect, which may be due to the failure of the method to properly account for underlying trends in labor market outcomes. The problems encountered in the above analysis may well be similar to theirs.

6.4 Policy analysis

The main analysis established a positive joint effect of the age-targeted tax credits, and the heterogeneity analysis indicated that the impact was primarily driven by men. Unfortunately, the attempt to separate the effect of the two tax credits gave no conclusive result. Still, for the reasons outlined in Section 3, we might expect the earned income tax credit to have a larger impact than the payroll tax credit. This section evaluates the size of the effects found in the above analysis. First, to facilitate comparison with other labor supply studies, I translate the estimated effects into elasticities. Second, I analyze the public finance implications of the reform. Both analyses are performed under the two scenarios that both tax credits contributed equally to the behavioral changes, on the one hand, or that the changes can be entirely attributed to the earned income tax credit, on the other hand. The first scenario is the most appropriate since there is no evidence of a differential impact, but the second scenario is an interesting alternative hypothesis. Furthermore, to give an indication of the fiscal implications in the hypothetical scenario that the reform effect for women would be as large as that for men, the public finance analysis is performed only for men as well as for the full sample.

6.4.1 Implied elasticities

Table 10 translates the estimated reform effects from the main analysis into elasticities, which can be interpreted as the percentage change in the outcome variable from a one percent increase in net labor income, due to the age targeted tax credits. The elasticities are presented for the full sample in panel A and for men only in panel B. The first row in each panel assumes that both tax credits were equally important for the observed effect. The second row assumes that the entire effect was due to the earned income tax credit, and presents the elasticity only with respect to the earned income tax credit. The elasticities are calculated as the percentage change in the outcome variable, from the last row of *Table 3*, divided by the percentage change in net labor earnings due to the different tax credits.

The change in net labor earnings due to the earned income tax credit is calculated from the average change in the logarithm of the net-of-income-tax rate due to the earned income tax credit for workers above age 65 in the treatment group during 2007–2009, which is 7.11 percent.[22] The change in net labor earnings due to the payroll tax credit is calculated as the change in the natural logarithm of the net-of-payroll-tax-rate from the 2007 reform, which is 13.68 percent. The total change is calculated as one minus the product of the net-of-income-tax rate and the net-of-payroll-tax rate, which is 19.82 percent.[23]

Table 10: Implied elasticities

	Employment (1)	Share of previous earnings (2)	Remunerated months (3)
A. Full sample			
Elasticity, effect from EITC and payroll tax credit	0.248	0.383	0.148
Elasticity, effect only from EITC	0.691	1.068	0.412
B. Men			
Elasticity, effect from EITC and payroll tax credit	0.349	0.565	0.195
Elasticity, effect only from EITC	1.006	1.631	0.563

The first row in panel A of *Table 10* suggests an elasticity of employment of 0.25, an elasticity of earnings as a share of previous earnings of 0.38 and an elasticity of the number of remunerated months of 0.15, under the assumption that both tax credits contributed equally to the observed effects. Assuming that the entire effect was due to the earned income tax credit, in the second row, gives an elasticity of employment of 0.69, an elasticity of earnings as a share of previous earnings of 1.07 and an elasticity of the number of remunerated months of 0.41. The elasticities for men, reported in panel B, are larger, ranging from 0.2 to 0.57 when accounting for both tax credits and from 0.56 to 1.63 when only accounting for the earned income tax credit. The elasticities for women are not reported since there were no significant effects of the tax credits for this group in the main analysis. They should thus be close to zero.

The estimated elasticities can be compared to results in the previous literature. Hotz

[22] This is based on *realized* earnings whereas the values in section 6.3 were based on *potential* earnings.

[23] For men only, the change due to the earned income tax credit is 6.77 percent and the total change is 19.52 percent.

and Scholz (2003) summarize the literature on the effects of expansions in the U.S. earned income tax credit on labor force behavior. They find elasticities of labor force participation with respect to net income of 0.69 to 1.69 among single women with children, which was the group primarily affected by the EITC, and regard elasticities of this size as large. Immervoll, Kleven, Kreiner and Saez (2007) review the evidence on participation elasticities in the labor supply literature, and find elasticities of 0.5 to 1 for certain subgroups of the population, such as married women and low income earners, and elasticities close to zero for prime-aged males. In their modeling, the authors use an average participation elasticity of 0.2, ranging from 0.4 in the lowest income decile to 0 in the highest income decile. In simulation studies of the Swedish earned income tax credit for workers below age 65, Sacklén (2009) obtains a relatively low participation elasticity of 0.1, whereas Aaberge and Flood (2008) obtain a participation elasticity of 0.3 for single mothers.

When only considering the earned income tax credit, the implied elasticity of employment with respect to net income in this study is high and compares well to the participation elasticities for women and low income earners in the previous literature. When considering the total impact of the earned income tax credit and the payroll tax reduction, however, the elasticities are small, at least if we believe that labor force participation should be more elastic among older workers than in the population in general. The elasticities do, however, compare with the participation elasticities for single women in Sweden from the simulation model in Aaberge and Flood (2008).

6.4.2 Public finance implications

The size of the estimated effects can also be evaluated by analyzing the public finance implications of the reform. As discussed in Palme and Svensson (2007), the overall change in public sector finances can be decomposed into a "mechanical" and a "behavioral" component. The mechanical component is the change in public finances if individuals would not change their retirement behavior, whereas the behavioral component is the change in public finances from the changes in retirement behavior due to the reform. *Table 11* presents the results from such a decomposition. The first column shows the results for all individuals in the treatment group after the reform, i.e., individuals who turned 65 in

November and December during 2007–2009 with previous earnings above the 2007 tax liability threshold. The second column presents the results for males only. Since the effects appeared to be driven primarily by men, these results give an indication of the public finance implications if women could be influenced to respond as much as men. The analysis accounts for the benefits and costs only during the tax year immediately following the 65th birthday for the treatment group, combined over the years 2007 to 2009.

The statistics used for the calculations are presented in panel A. To perform the analysis, I need to make a number of simplifying assumptions. I only consider the estimated effect on the employment outcome variable. To measure the behavioral effect, I use the employment estimate to calculate the number of individuals who were added to the labor force as a result of the reform. I assume that the individuals who were encouraged to work by the reform have the same distribution of earnings as the individuals who would have worked regardless of the reform. Thereby, the realized average earned income tax credit, average payroll tax credit, average labor income taxes and average net labor income in the treatment group during 2007–2009 can be taken as representative for all individuals. The analysis is simplified by the fact that the public pension system is actuarially fair. A delayed labor force exit therefore has no public finance implications in terms of public pension payments. Workers above age 65 are also not eligible for social programs such as unemployment and disability benefits.

Panel B calculates the mechanical cost of the reform for individuals in the treatment group during 2007–2009, disregarding the behavioral effect. The costs are the payments of the earned income tax credit and the payroll tax credit, given by the average size of the tax credit payments times the number of individuals attributed to the mechanical component. I assume that all tax credit payments are used for consumption, which implies that there are also benefits of the reform in terms of value added tax payments. Following Pirttilä and Selin (2011), I use an effective value added tax rate of 21 percent. Adding the costs from the tax credit payments and subtracting the benefits from the value added tax payments gives the total mechanical cost of the reform, amounting to 405 million SEK for the full sample and 258 million SEK for the male sample.

Panel C calculates the benefits of the reform that can be attributed to the behavioral

component. In terms of income taxes, the benefits are the additional personal income tax and payroll tax payments of individuals induced to work by the reform. Assuming that all income is used for consumption, there are also benefits from value added taxes on net labor income. Adding these benefits together gives the total benefits of the reform that can be attributed to the behavioral component, amounting to about 54 million SEK for both the full and the male sample. The benefits are similar for the two samples since the behavioral effects primarily could be attributed to men.

Table 11: Public finance implications of the age-targeted tax credits

	Men and women (1)	Men (2)
A. Statistics used for calculations		
Employment estimate	0.015	0.024
No. individuals	35,142	18,207
No. employed individuals	11,951	7,140
of which attributed to mechanical component	11,422	6,698
of which attributed to behavioral component	529	442
Mean EITC, SEK	8,486	8,475
Mean payroll tax credit, SEK	36,423	40,349
Mean labor income taxes, SEK	69,872	87,708
Mean net labor income, SEK	155,517	161,974
B. Mechanical component		
Costs, EITC, million SEK	96.9	56.8
Costs, payroll tax credit, million SEK	416.0	270.3
Benefits, VAT on EITC, million SEK	20.4	11.9
Benefits, VAT on payroll tax credit, million SEK	87.4	56.8
Total costs, mechanical component, million SEK	405.0	258.3
C. Behavioral component		
Benefits, labor income taxes, million SEK	37.0	38.8
Benefits, VAT on net labor income, million SEK	17.3	15.0
Total benefits, behavioral component, million SEK	54.2	53.8
D. Behavioral benefits as a share of mechanical costs		
Share, effect from EITC and PT	0.134	0.208
Share, effect only from EITC	0.708	1.200
E. Estimates required for a fully financed reform		
Employment estimate, effect from EITC and PT	0.112	0.117
Employment elasticity, effect from EITC and PT	1.762	1.634
Employment estimate, effect only from EITC	0.021	0.020
Employment elasticity, effect only from EITC	0.948	0.832

Individuals turning 65 Nov–Dec 2007–2009 with previous earnings above 17,100 (2007 SEK). Degree of self financing is the sum of extra income taxes, extra VAT income and extra VAT tax credits total divided by the total cost. Values in 2007 SEK.

Panel D calculates the degree to which the benefits from the behavioral changes coun-

teract the mechanical costs of the reform. This can be thought of as the reform's degree of "self financing". The first row presents the results of this exercise under the assumption that both tax credits contributed equally to the observed changes in retirement behavior, whereas the second row presents the results assuming that all of the effect was due to the earned income tax credit. The costs of the earned income tax credit and the payroll tax credit are large, and the behavioral changes can only account for 13 percent of the mechanical costs of the reform for the full sample, and 21 percent for the male sample. If attributing all of the behavioral changes to the earned income tax credit, and disregarding the costs of the payroll tax credit, the degree of self financing increases to 70 percent for the full sample and 120 percent for the male subsample. Under those assumptions, the behavioral changes for males are in fact large enough to fully finance the reform.

Finally, panel E presents calculations of the employment estimates and elasticities that would be required for the benefits from the behavioral component to fully finance the costs of the mechanical component of the reform. Considering the total costs of the earned income tax credit and the payroll tax credit, in the first two rows, would require employment estimates of 0.11–0.12 and employment elasticities of 1.6–1.8, which are arguably very large. Only considering the earned income tax credits, in the two last rows, reduces the required employment estimates to about 0.02 and the employment elasticities to 0.8–0.9, which are of more reasonable sizes compared to estimates in the previous literature.

The assumptions made in the analysis can of course be questioned. First, the estimated effect on taxable earnings might be a more appropriate benchmark than the effect on employment. The effect on earnings could not be significantly separated from zero in the analysis, which implies that the behavioral component would be zero. Since the other measures indicated a positive labor supply response, however, there is reason to believe that there is a behavioral response that the earnings variable is unable to recover. Second, even if the effect on employment is used as a benchmark, the assumption that the realized earnings distribution is representative for individuals induced to work by the reform can be questioned. It might be more likely that the individuals who entered employment as a result of the reform work less than those who would have continued to work regardless

of the reform. Both of these concerns would imply that the behavioral component is overrated, and that the degree of self financing is even lower.

There are also other caveats to the analysis. First, the control group can be argued to also be treated by the reform. The tax credits will accrue to the control group with a delay, one year later than to the treatment group, which might induce them to remain in employment until becoming eligible for the tax credits. Such behavior would attenuate the behavioral effects. In addition, the results from the main analysis suggest that the responsiveness to the reform has increased over time, and may hence be even larger in the future. Furthermore, the analysis only considers the costs and benefits of the reform during the year immediately following the 65th birthday, for individuals in the narrowly defined treatment group. This is the only effect that can be established in the paper. A full analysis would take into account the costs and benefits for all individuals affected by the reform. Finally, the analysis does not take welfare, but only public finance considerations, into account. A full welfare analysis may give very different implications, but is beyond the scope of this paper.

7 Conclusion

This paper studies the impact of an earned income tax credit and a payroll tax credit targeted at workers above age 65 that were simultaneously introduced in Sweden in 2007. The identification strategy exploits that the eligibility for the two tax credits was governed by the year of birth, while the social security system is governed by age at retirement, which creates a discontinuity in labor tax rates that is due to the timing of the 65th birthday around the new year. Other differences between the groups are controlled for using a difference-in-differences approach, to the extent that they do not change discontinuously at the time of the reform. The sample consists of individuals who turned 65 from November to February between 2001 and 2009 and had annual earnings above the 2007 tax liability threshold three to five years earlier.

The results suggest a positive effect of the age-targeted tax credits on labor market outcomes in the estimation sample. In the year immediately following the 65th birthday,

employment in the treatment group increased by 1.5 percentage points, annual earnings as a share of previous earnings increased by 1.8 percentage points and the number of remunerated months increased by 0.13, although the effect on taxable labor earnings is insignificant. The results are shown to be robust to a variety of robustness checks. An analysis of heterogeneous responses indicates that the effects can primarily be attributed to men, increase with education and are particularly large for self-employed. Other institutions may discourage a delayed retirement for women and low educated workers, and the tax credits may need to be combined with other reforms to impact the retirement behavior of these groups. To study the relative contribution of the two types of labor tax credits I use the variation in the size of the credits by income and year, but unfortunately the analysis gives no conclusive result.

I also evaluate the size of the effects found in the analysis. To facilitate comparison with previous studies, the estimated effects are translated into elasticities. Attributing the behavioral changes to both tax credits, which is appropriate since there was no evidence of a differential impact, gives implied elasticities of 0.25 for employment, 0.38 for annual earnings as a share of previous earnings and 0.15 for the number of remunerated months. In addition, a rough analysis of the public finance implications of the reform suggest that the benefits from the behavioral changes amount to only a small share of reform costs for the estimation sample. Much of the previous research on earned income tax credits has focused on low income earners. This paper provides new evidence of the effectiveness of tax credits for workers at the margin of retirement. The implied elasticities found in this study are small compared to the elasticities in the U.S. earned income tax credit literature. Interestingly, since the costs of the two tax credits were substantial, a fully financed reform would require unusually large employment elasticities, compared to what has typically been found in the labor supply literature.

Two previous reports to the Swedish government have analyzed the impact of the age-targeted tax credits on labor market outcomes using a difference-in-differences approach. Pirttilä and Selin (2011) compare the employment rates from the Labor Force Survey of the age groups 65–74 and 55–64 before and after the reform in 2007, and find an increase in employment of 2 percentage points or 19.4 percent in the older age group. The authors

emphasize that the analysis is suggestive and merely points in interesting directions for future work. The Ministry of Finance (2012) compare labor market outcomes between individuals aged 66 and 64 and between individuals who turned 65 in the first and the last quarter of the year, before and after 2007. The former analysis suggests an employment increase of 7 percentage points, whereas the estimates in the latter analysis are insignificant. The advantage of the present analysis compared to these studies is that the control and treatment groups are more similar due to the narrow age span of only a few months. With less similar groups it may be difficult to account for differential trends over time. The results in this study suggest that the previous estimates are likely to overstate the change in employment.

Although the tax credits, in terms of foregone tax revenues, showed to be a costly way to increase labor supply at older ages, changes in retirement behavior may have long-run benefits that are not accounted for in this study and that may interact with other possible future policy changes. There are also other limitations to the analysis in this paper. Since the control group eventually becomes eligible, the analysis captures the effect of receiving the tax credits one year earlier. If the control group delays their labor force exit until becoming eligible, the estimated effects will be attenuated. In addition, only the short-term effects during the year immediately following the 65th birthday are being analyzed. Instead of a static model, one could consider a dynamic model in which the tax credits affect the option value of retirement. This may reduce the change in financial incentives and lead to larger implied elasticities. Considering the dynamic effects of the age-targeted tax credits on retirement incentives is an avenue for future research.

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Appendix

Table A-1: Summary statistics

	Treatment Group (1)	Control Group (2)
Female	0.485	0.488
Less than High School	0.349	0.331
High School	0.399	0.401
College	0.252	0.268
Immigrant	0.108	0.113
Previously sick	0.395	0.399
No spouse	0.309	0.307
Older spouse	0.314	0.303
Younger spouse	0.378	0.390
Self-employed	0.068	0.066
Previous earnings	240,837	242,403
Observations	86,161	95,023

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Treatment and control groups consist of individuals turning 65 in Nov–Dec and Jan–Feb, respectively, 2001–2009, with previous earnings above 17,100 (2007 SEK).

Table A-2: The effect of being included in the estimation sample on the reform indicator and the effect of covariates on the probability of being included in the sample

Variables	Reform indicator	Included in the estimation sample
	(1)	(2)
Included	0.0016	
	(0.0010)	
Female		-0.008***
		(0.002)
High School		0.075***
		(0.002)
College		0.170***
		(0.002)
Immigrant		-0.183***
		(0.002)
Self-employed		0.211***
		(0.004)
Previously sick		-0.197***
		(0.002)
Older spouse		0.043***
		(0.002)
Younger spouse		0.082***
		(0.002)
Constant	0.2026***	0.711***
	(0.0017)	(0.002)
Year dummies	Yes	No
Age dummies	Yes	No
R-squared	0.6088	0.122
Observations	257,104	257,104

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Individuals turning 65 Nov–Feb 2001–2009.

Table A-3: The effect of the age-targeted tax credits on labor market outcomes for the excluded sample

Variables	Employment	Taxable labor earnings	Share of previous earnings	Remunerated months
	(1)	(2)	(3)	(4)
Reform	0.002	399	0.097	0.009
	(0.002)	(267)	(0.125)	(0.036)
Constant	0.015***	3,114***	0.320***	0.664***
	(0.002)	(312)	(0.101)	(0.043)
R-squared	0.006	0.009	0.001	0.017
Observations	75,920	75,920	75,920	75,920

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Individuals turning 65 Nov–Feb 2001–2009 with previous earnings below 17,100 (2007 SEK). Employed if earnings>1 income base amount. Includes the controls in Table *Table 3*.

Table A-4: The effect of the age-targeted labor tax credits on labor market outcomes using the Donald and Lang (2007) two-step approach

Variables	Employment	Taxable labor earnings	Share of previous earnings	Remunerated months
	(1)	(2)	(3)	(4)
Reform	0.015*	1,529	0.018***	0.128**
	(0.007)	(1,532)	(0.004)	(0.041)

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Individuals turning 65 Nov–Feb 2001–2009 with previous earnings above 17,100 (2007 SEK). Employed if earnings>1 income base amount. Includes the controls in Table *Table 3*.

Table A-5: The effect of the age-targeted labor tax credits on labor market outcomes, without controls

Variables	Employment	Taxable labor earnings	Share of previous earnings	Remunerated months
	(1)	(2)	(3)	(4)
Reform	0.015***	1,493	0.018***	0.133**
	(0.004)	(1,389)	(0.005)	(0.053)
Constant	0.180***	31,736***	0.143***	3.336***
	(0.004)	(963)	(0.004)	(0.049)
Controls	No	No	No	No
Year dummies	Yes	Yes	Yes	Yes
Age dummies	Yes	Yes	Yes	Yes
R-squared	0.024	0.021	0.015	0.015
Observations	181,184	181,184	181,184	181,184

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Individuals turning 65 Nov–Feb 2001–2009 with previous earnings above 17,100 (2007 SEK). Employed if earnings>1 income base amount.

Table A-6: The effect of the age-targeted labor tax credits on labor market outcomes for different sample selections

Sample	Employment	Taxable labor earnings	Share of previous earnings	Remunerated months
	(1)	(2)	(3)	(4)
December-January	0.011*	2,720	0.017***	0.141*
	(0.006)	(1,933)	(0.006)	(0.072)
November-February	0.015***	1,518	0.018***	0.133***
	(0.004)	(1,335)	(0.004)	(0.051)
October-March	0.014***	-232	0.012***	0.122***
	(0.003)	(1,076)	(0.004)	(0.041)

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Individuals turning 65 Oct–Mar 2001–2009 with previous earnings above 17,100 (2007 SEK). Employed if earnings>1 income base amount. Includes the controls in Table *Table 3*.

Table A-7: The effect of the age-targeted labor tax credits on the probability of earning more than a certain cutoff in income base amounts

Variables	> 0 (1)	> 0.5 BA (2)	> 1 BA (3)	> 1.5 BA (4)	> 2 BA (5)	> 3 BA (6)
Reform	0.0170***	0.0222***	0.0150***	0.0107***	0.00332	0.00279
	(0.00458)	(0.00449)	(0.00428)	(0.00407)	(0.00387)	(0.00351)
Constant	0.451***	0.338***	0.282***	0.239***	0.208***	0.163***
	(0.00575)	(0.00543)	(0.00506)	(0.00474)	(0.00447)	(0.00397)
R-squared	0.070	0.083	0.086	0.085	0.084	0.081
Observations	181,184	181,184	181,184	181,184	181,184	181,184

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Individuals turning 65 Oct–Mar 2001–2009 with previous earnings above 17,100 (2007 SEK). Includes the controls in Table *Table 3*. BA=income base amount, 45,900 SEK in 2007 ($ 6,600).

Table A-8: The effect of the age-targeted labor tax credits on the probability of working more than a certain number of months

Variables	> 0 months (1)	> 3 months (2)	> 6 months (3)	> 9 months (4)
Reform	0.0213***	0.00977**	0.0111**	0.0109**
	(0.00460)	(0.00453)	(0.00448)	(0.00442)
Constant	0.388***	0.338***	0.316***	0.306***
	(0.00568)	(0.00550)	(0.00541)	(0.00534)
R-squared	0.075	0.073	0.071	0.069
Observations	181,184	181,184	181,184	181,184

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Individuals turning 65 Oct–Mar 2001–2009 with previous earnings above 17,100 (2007 SEK). Includes the controls in Table *Table 3*.

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