The Effect of Age-Targeted Tax Credits on Retirement Behavior

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Abstract

I analyze the effect of income tax policy changes on retirement behavior by exploiting two age-targeted policy initiatives to delay retirement simultaneously implemented in Sweden in 2007: an earned income tax credit and a payroll tax credit for workers above age 65. Using an age-based discontinuity in eligibility criteria, I conduct a difference-in-difference analysis with the reform as an instrument for the net-of-tax rate. I find a participation elasticity of 0.15–0.20 and a zero taxable income elasticity. Calculations indicate that the employment effect was not large enough to offset the implied decrease in tax revenues.

JEL Classification: H24, J14, J18, J21
Keywords: Labor supply, Retirement, Earned income tax credit, Payroll tax

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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 postpone labor force exit has been through social security reform. Financial incentives for early retirement inherent in many social security systems have been removed and age limits have been increased. Gruber and Wise (1999) show that the design of social security programs is indeed important for explaining cross-country differences in retirement behavior, and French (2005) and Laun and Wallenius (2014) suggest that pension reforms have large potential. The empirical literature exploiting more or less exogenous variation, however, often finds moderate effects of pension benefits on retirement behavior.[1]

Although social security reform may be an inexpensive way to delay retirement, it can be politically controversial. An alternative approach to encourage a postponed labor force exit, that has not yet been widely used, is to decrease labor tax rates near retirement. Policies aimed at motivating individuals to work longer may be easier to promote than forcing regulations for delayed retirement. If labor supply at older ages is responsive to tax changes, the cost of reduced tax rates can be offset by the revenue from an increased tax base. If not, tax credits for older workers will merely work as a transfer to those who would have continued to work regardless. Despite the voluminous literature on the impact of tax changes on labor supply, no study has explicitly focused on older workers. Previous research shows that the participation decision appears to be the most responsive margin of labor supply, and that certain groups, such as women and low-educated, respond more to tax changes than prime-aged males.[2] Workers at the margin of retirement are another group with a potential labor supply reserve, in particular at the extensive margin. Banks and Diamond (2010) promote the idea of age-dependent earnings taxes.

In this paper, I study the effect of income tax policy changes on retirement behavior. I use a quasi-experimental approach, exploiting 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 for workers above age 65. The identification strategy utilizes a feature inherent in the design of the tax policies. Eligibility for the age-targeted tax credits is determined by the age at the beginning of the tax year, which creates a discontinuity in labor income tax rates that depends on the timing of the 65th birthday around the year-end. I use this discontinuity to define treatment and control groups and perform a difference-in-differences analysis in which the post reform and treatment group interaction is used as an instrument for participation and marginal net-of-tax rates. An advantage compared to previous studies is that treatment status is not defined based on previous income, which makes income controls less crucial in the estimation.

The analysis studies if the age-targeted labor tax credits affected retirement behavior in the year following the 65th birthday, when tax incentives differ for the treatment and control groups. I estimate labor supply elasticities at the extensive as well as the intensive margin. To shed further light on the policy implications of the reform, I also provide calculations for

[1] See, e.g., Brown (2013), Chetty, Guren, Manoli, and Weber (2012), Johansson, Laun, and Palme (2014) and Manoli and Weber (2011).

[2] See, e.g., Blundell and Hoynes (2004), Eissa and Hoynes (2006), Immervoll, Kleven, Kreiner, and Saez (2007), Meghir and Phillips (2010) and Saez, Slemrod, and Giertz (2012) for reviews.

the tentative effects on public finances. The data cover individuals who turned 65 around the year-end, from October to March, between 2001 and 2010 and had earnings above one income base amount (SEK 45,900 or about $6,600 in 2007) three to four years earlier.

The results suggest that the age-targeted tax credits impacted labor supply at the extensive but not at the intensive margin. The participation elasticity with respect to the net-of-participation-tax rate is estimated to about 0.15–0.2. The elasticity of taxable labor income with respect to the global marginal net-of-income-tax rate, however, cannot be significantly separated from zero. An analysis of heterogeneous responses indicates that the participation responses are somewhat larger for women and healthier individuals, and that self-employed respond at the intensive rather than the extensive margin. A rough analysis of the public finance implications of the reform suggests that the benefits from the behavioral changes amount to only a small share of reform costs. Interestingly, since the costs of the two tax credits are substantial, a fully financed reform would require unusually large employment elasticities, compared to what has typically been found in the literature.

The study 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 suggest that social security reform is not the only way to enhance the incentives for a delayed labor force exit. Another approach, that may be more salient and less politically controversial, is to consider the incentives in the income tax system, affecting the gains from working directly. This strategy, however, appears to come at a substantial cost. 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.[3] 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 may 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 presents a basic theoretical framework. Section 4 outlines the empirical strategy and describes the data. Section 5 presents the empirical results and Section 6 concludes the paper.

2 Institutional Background

2.1 The Swedish Income Tax System and the Age-Targeted Tax Credits

In the Swedish income tax system, the individual is the tax-paying unit. 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

[3]The Swedish earned income tax credit has primarily been assessed in simulation studies such as Aaberge and Flood (2008), Ericson and Flood (2009) and Sacklén (2009). Edmark, Liang, Mörk, and Selin (2012) try a quasi-experimental approach but conclude that the impact of the Swedish earned income tax credit for workers below age 65 is difficult to evaluate. Two previous reports to the Swedish government, Pirttilä and Selin (2011) and Ministry of Finance (2012), find employment effects of the age-targeted tax credits, but the analyses are suggestive and merely points in interesting directions for future work.

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. In 2007, the standard deduction ranged from SEK 17,100 to 31,100 ($2,400 to 4,400). 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 breakpoints, with a tax rate of 20 percent above the first and 25 percent above the second breakpoint. In 2007, the first breakpoint was SEK 328,600 ($46,900) and the second breakpoint was SEK 488,600 ($69,800).[4]

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 is substantially larger for workers aged 65 or above at the beginning of the tax year.[5] Apart from age, the size of the tax credit is a function of the earned income, the standard deduction and the local government tax rate. It is a non-refundable credit that cannot reduce the local government tax liability below zero and it is deducted automatically on the monthly paycheck. The earned income tax credit was expanded in 2008, 2009, 2010 and 2014.

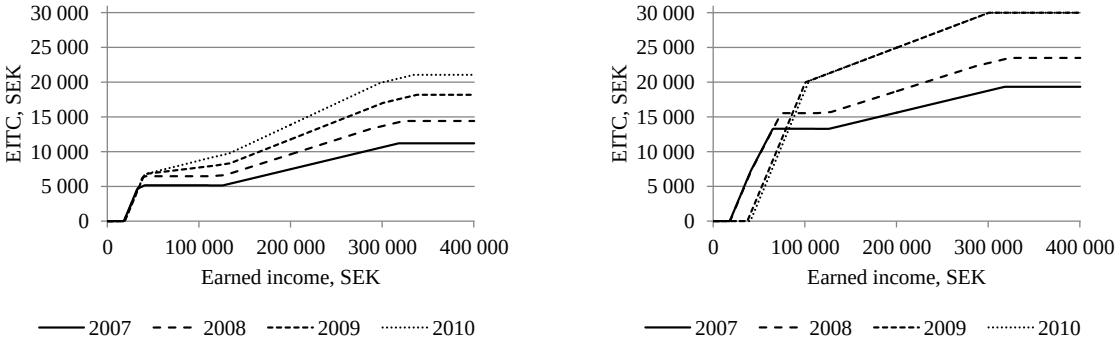
Figure 1 presents the structure of the earned income tax credit during 2007–2010, assuming the average local tax rate and no taxable transfers.[6] Figures 1(a) and 1(b) show the earned income tax credit as a function of earned income for workers below or above age 65 at the beginning of the tax year. Unlike most earned income tax credits in other countries, there is 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, which applied to transfer income as well as labor income. The earned income tax credit for older workers was therefore made independent of the standard deduction and the shape of the tax credit changed. 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.

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 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

[4] I use an exchange rate of 7 SEK for 1 USD throughout the paper.

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

[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.



(a) EITC below age 65

(b) EITC above age 65

Figure 1: The structure of the earned income tax credit during 2007–2010 for workers below and above age 65, assuming no taxable transfers

introduction of a new pension system. The payroll tax rate for self-employed below age 65 has also traditionally been slightly lower than for regular employees.

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 2001–2010. 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. The lower rate for older workers applies to both regular employees and self-employed. 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 for older workers.

Figure 2: The payroll tax rate by age at the beginning of the tax year during 2001–2010

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, well before the age-targeted tax credits were introduced.

3 Theoretical Framework

In the standard labor supply model, the individual maximizes utility from consumption c and labor l subject to an individual budget constraint. It has been recognized, however, that there are other margins of behavioral responses to taxation than hours worked, such as intensity of work, career choices, form of compensation, tax avoidance, tax evasion, etc. Following Lindsey (1987) and Feldstein (1995), a growing body of research has studied the elasticity of taxable income with

respect to the net-of-tax rate. The idea is that taxable income includes all responses to taxes that the government cares about. Gruber and Saez (2002) generalize the standard labor supply model to account for responses along these other margins by letting the individual maximize utility from consumption c and taxable income z.

I follow Lehmann, Marical, and Rioux (2013) to characterize the individual budget constraint for the Swedish case, which includes a progressive income tax and a linear payroll tax. I distinguish between the *gross* labor income w paid by the employer, the *taxable* labor income z received by the worker and the *net* labor income c consumed by the worker. The taxable labor income is $z = (1 - \tau^P) \cdot w$, where τ^P is the payroll tax rate. The net labor income on a linear part of the income tax schedule is $c = (1 - \tau^I) \cdot z + E$, where τ^I is the marginal income tax rate and E is the virtual income generated by the tax and transfer system. Combining these expressions gives the individual budget constraint:

$$c = (1 - \tau^I) \cdot (1 - \tau^P) \cdot w + E.$$

Maximization yields an optimal taxable labor income supply function $z(1 - \tau^G, E)$ where z depends on the global marginal net-of-tax rate $1 - \tau^G = (1 - \tau^I) \cdot (1 - \tau^P)$ and the virtual income E. As discussed in Saez, Slemrod, and Giertz (2012), it is standard in much of the literature to assume that there are no income effects since there is little empirical evidence on their existence. I also assume no income effects so that the income function z does not depend on E.

Taxes on labor income can affect the supply of labor, or effort, on the extensive as well as on the intensive margin. Meghir and Phillips (2010) summarize the research on labor supply and taxes. A general conclusion is that the decision to participate in the labor market is quite sensitive to taxation for groups of workers with a large labor supply reserve, such as women and low-educated. The hours of work margin is not particularly responsive for men but a little more responsive for women. There are no previous studies on labor supply responses to tax changes for workers at the margin of retirement. Chetty, Guren, Manoli, and Weber (2012) reconcile the evidence on the impact of pension benefits on labor supply and find extensive margin elasticities of about 0.25. For workers near retirement, the participation decision is likely to be important.

Saez (2002) models labor supply responses along both the extensive and the intensive margin. The participation decision can be incorporated in the classical labor supply model assuming that individuals face fixed costs of entry or cannot freely choose hours of work. Each individual has a skill level $i \in \{0, 1, ..., I\}$ and chooses to work in occupation i or to be unemployed. The decision to work depends on the difference between the net labor income when working c and the after tax income when not working c_0. Work incentives are summarized by the participation tax rate τ^A, defined as one minus the financial gain to work as a proportion of gross labor income w, i.e.,

$$\tau_i^A = 1 - \frac{(c_i - c_0)}{w_i}.$$

The size of the behavioral response at the extensive margin can then be captured by the participation elasticity, i.e., the percentage change in labor force participation following a percentage

change in the financial gain from working. It is defined for $i = 1, ..., I$ as

$$\eta_i = \frac{c_i - c_0}{h_i} \frac{\partial h_i}{\partial (c_i - c_0)},$$

where h_i is the proportion of individuals in occupation i.

At the intensive margin, the key measure of work incentives is the marginal net-of-tax rate. It captures how much of a small rise in gross earnings is lost to payments of tax and reduced entitlements to benefits. The elasticity of taxable earnings z with respect to the marginal net-of-tax rate $1 - \tau^G$ is defined as:

$$e = \frac{1 - \tau^G}{z} \frac{\partial z}{\partial (1 - \tau^G)}.$$

4 Empirical Strategy

4.1 Identification

In order to identify behavioral responses to taxation, it is necessary to find instruments that are correlated with the net-of-tax rate but uncorrelated with potential income. A common approach has been to use tax rate changes created by tax reforms. As discussed in Saez, Slemrod, and Giertz (2012), the recent elasticity of taxable income literature has primarily used tax reforms with different tax rate changes along the income distribution. In particular, the largest tax rate changes have often taken place at the top of the income distribution. It has been well recognized in this literature that since the instruments depend on pre-reform income, they may be correlated with the error term if the pre-reform income level is correlated with the error term. This may occur because of non-tax related changes in gross labor income that may be specific to income groups, or simply because of mean reversion. The previous literature has therefore also discussed the importance of controlling for pre-reform income.

Participation responses to tax rate changes have primarily been studied in the context of earned income tax credits affecting certain groups of workers. The focus has been on the Earned Income Tax Credit (EITC) in the U.S. and the Working Families Tax Credit (WFTC) in the U.K., mainly targeted towards low income families. Eissa and Hoynes (2006) and Blundell and Hoynes (2004) summarize the evidence and show that participation responses have been large for the targeted groups. The Swedish earned income tax credit is different in that it is available to all workers and has no phase-out region. Therefore, there is no natural control group. Edmark, Liang, Mörk, and Selin (2012) try a quasi-experimental approach to study the labor supply effects of the Swedish earned income tax credit for workers below age 65, using the variation in the size of the tax credit due to differences in local tax rates. However, they come to the conclusion that the variation is too small to estimate any reliable effects.

In this study, I exploit a feature inherent in the design of the tax policies for identification. Eligibility for the age-targeted tax credits is determined by the age at the beginning of the tax year, which creates a discontinuity in labor income tax rates that depends on the timing of the 65th birthday around the year-end. Individuals who turn 65 just before the year-end are eligible for the tax credits from 1 January while individuals who turn 65 just after the year-end are eligible for the tax credits one year later. This gives a unique opportunity to define treatment

and control groups, since similar individuals of roughly the same age experience different tax rates at the same point in time. 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, when tax incentives differ for the two groups. An advantage compared to what has typically been done in the elasticity of taxable income literature is that identification does not come from differences along the income distribution, which reduces the importance of controlling for pre-reform income.

Individuals who turn 65 on different sides of the year-end may differ in terms of labor market outcomes even in absence of any 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 earlier, 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 (2013) 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 in a difference-in-differences estimation framework.

4.2 Estimation

To study the impact of the age-targeted earned income tax and payroll tax credit, I rely on a difference-in-differences approach in which changes in participation and taxable labor income of a treatment group is compared to changes for a control group not experiencing the same tax change. Saez, Slemrod, and Giertz (2012) survey the elasticity of taxable income literature and describe the main estimation strategies that have been used in the literature. Difference-in-differences analysis can be carried out as a cross-section analysis or as a panel analysis, and the authors stress that cross-section analysis in many contexts may be a more robust and transparent approach. Motivated by this, the main approach in this paper is a cross-sectional difference-in-differences analysis. A panel analysis is presented in the robustness section.

Let us denote by T the treatment group of individuals with birthday before the year-end and C the control group of individuals with birthday after the year-end. Let us further denote the reform year 2007 by $\bar{t}$. Using a cross-section of individuals who turn 65 on different sides of the year-end during a period of pre- and post-reform years I estimate the two-stage least squares regressions:

$$P_{i,t} = e \cdot \log \tau_{i,t}^{A} + \alpha \cdot 1(t \geq \bar{t}) + \beta \cdot 1(i \in T) + \epsilon_{i,t}, \tag{1}$$

for extensive margin responses and

$$\log z_{i,t} = e \cdot \log \tau_{i,t}^{G} + \alpha \cdot 1(t \geq \bar{t}) + \beta \cdot 1(i \in T) + \epsilon_{i,t}, \tag{2}$$

for intensive margin responses, where the post reform and treatment group interaction $1(t \geq \bar{t}) \cdot 1(i \in T)$ is used as an instrument for $\log \tau^{A}$ and $\log \tau^{G}$.

The identifying assumption for these formulas to produce unbiased estimates of the elasticity parameters is that the outcome variables would have followed parallel trends in the treatment

and control groups in absence of the tax reform. If the parallel trends assumption is violated, the formulas can be generalized to also include separate time trends for the control and treatment groups. At the extensive margin, I estimate

$$P_{i,t} = e \cdot \log \tau^A_{i,t} + \alpha \cdot 1(t \geq \bar{t}) + \beta \cdot 1(i \in T) + \gamma_C \cdot t + \gamma_T \cdot t \cdot 1(i \in T) + \epsilon_{i,t}, \tag{3}$$

where $P_{i,t}$ is employment status of individual i in year t, $\log \tau^G_{i,t}$ is the net-of-participation-tax rate and $\epsilon_{i,t}$ is an error term that captures unobserved and time-varying heterogeneity. At the intensive margin, I estimate

$$\log z_{i,t} = e \cdot \log \tau^G_{i,t} + \alpha \cdot 1(t \geq \bar{t}) + \beta \cdot 1(i \in T) + \gamma_C \cdot t + \gamma_T \cdot t \cdot 1(i \in T) + \epsilon_{i,t}, \tag{4}$$

where $\log z_{i,t}$ is the log taxable labor income and $\log \tau^G_{i,t}$ is the global marginal net-of-tax rate. Again, the post reform and treatment group interaction is used as an instrument for $\log \tau^A$ and $\log \tau^G$.

4.3 Data

The data set has been constructed by Statistics Sweden based on several administrative registers, including the Income and Tax Register (IoT), the Longitudinal Database on Education, Income and Employment (LOUISE) and the Register-Based Labor Market Statistics (RAMS). It covers the full Swedish working age population and contains detailed tax return information for each individual along with a large set of socioeconomic variables such as education level, municipality of residence, the collection of public transfers, immigration status, employment status, sector of employment and household identifiers. 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 includes individuals who turned 65 within three months around the year-end, i.e., from October to March, during 2001–2010.[7] The year of analysis, t, is the year in which individuals with birthday after the year-end turn 65 and individuals with birthday before the year-end turn 66, i.e., when only the latter group is eligible for the age-targeted tax credits. The analysis is restricted to individuals with annual labor earnings above one income base amount (SEK 45,900 or about $\$6,600$ in 2007) in year $t-3$ and year $t-4$.[8] To be included in the estimation of intensive margin responses, individuals must also have positive earnings in period t.

For the extensive margin analysis the outcome variable is employment, defined as having positive earnings. For the intensive margin analysis the outcome variable is taxable labor income, which is the sum of labor income from formal employment and self-employment net of certain costs for acquiring the income.[9] Data from the baseline year $t-3$ are used to construct individual characteristics, such as self-employment status, immigrant status and the municipality and county of residence. A variable of previous sickness indicates that the individual received

[7] Before 2001, individuals above age 65 are not included in the data set.

[8] 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.

[9] In a sensitivity analysis, other cutoffs for employment are being used, as well as extensive margin responses based on the number of remunerated months.

sickness or disability benefits from the Social Insurance Agency during the baseline year.[10] Using household identifiers, I identify the spouse in the baseline year and record whether the spouse was employed in the baseline year. Education level is determined by the maximum level during the studied period.

Table 1 presents summary statistics for the treatment and control group. The first two columns show the raw averages in baseline characteristics and the third column shows the difference between the two groups. 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. Individuals in the treatment group are also less likely to have an employed spouse, which is probably also due to the small age difference. Individuals in the treatment group are slightly less likely to be female or immigrants, slightly more likely to be self-employed and has slightly lower earnings. There is no difference in previous sickness incidence.

Table 1: Summary statistics and estimation of the reform indicator on covariates

Variables	Treatment group	Control group	Difference	Estimation of reform on covariates
	(1)	(2)	(3)	(4)
Female	0.479	0.482	-0.003*	0.000
	(0.002)	(0.001)	(0.002)	(0.001)
Self-employed $t-3$	0.058	0.056	0.002**	-0.003
	(0.001)	(0.001)	(0.001)	(0.002)
College	0.276	0.293	-0.016***	-0.002
	(0.001)	(0.001)	(0.002)	(0.001)
Sick $t-3$	0.237	0.239	-0.002	0.001
	(0.001)	(0.001)	(0.002)	(0.001)
Spouse employed $t-3$	0.463	0.477	-0.014***	-0.002*
	(0.001)	(0.001)	(0.002)	(0.001)
Immigrant	0.101	0.103	-0.002*	0.002
	(0.001)	(0.001)	(0.001)	(0.002)
Earnings $t-3$	244,706	248,678	-3,972***	0.000
	(503)	(462)	(683)	(0.000)
County dummies				Yes
Year dummies				Yes
Age dummies				Yes
Observations	110,912	130,137	241,049	241,049
F-test				0.903
Prob > F				0.609

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, during 2001–2010, with previous earnings above 45,900 (2007 SEK) in year $t-3$ and $t-4$.

Even if there are significant differences in characteristics between the treatment and control group this is no threat to identification. Permanent differences between the groups are captured by the treatment group indicator. What is important for identification is that the characteristics of the two groups do not change at the same time as the age-targeted tax credits were implemented. The fourth column in Table 1 reports the results from a regression of the individual characteristics on a reform indicator that takes the value 1 from 2007 onwards, while controlling

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

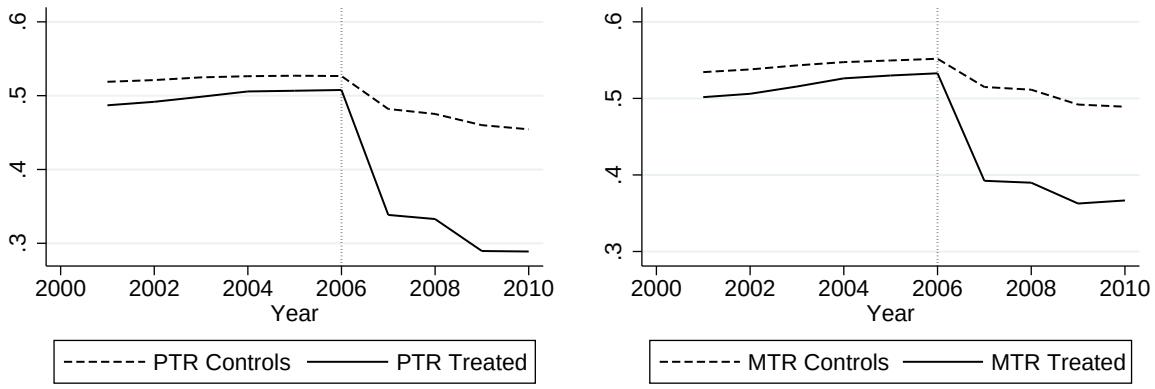
for age and time effects. An F-test tests the joint restriction of all coefficients on the covariates being zero. The F-statistic suggests that this restriction cannot be rejected, which is reassuring. It means that the characteristics of the sample remained stable around the implementation of the reform.

4.4 Variation in Tax Rates

Participation and marginal tax rates are not directly observed in the data. Instead, they are simulated based on tax return information and a complete model of the Swedish tax system for the period 1997–2010. The model takes into account changes in local and central government tax rates, the basic deduction, the earned income tax credit and the payroll tax rate. The institutional details accounted for in the tax simulation model are presented in Appendix A.

An obvious problem when studying extensive margin responses is the lack of an earnings measure for non-workers. To arrive at a measure of the participation tax rate, I impute taxable labor income by regressing z_t for those with positive earnings on a fourth order polynomial of base year taxable labor income z_{t-3} and indicators for gender, education level, year, age and county of residence. I use the formula (3) to calculate the net-of-participation-tax rate, where c_i is the net income from labor and other sources, primarily pension benefits for workers above age 65, c_0 is the net income if the worker would only have the income from other sources, and w is the gross wage if working. The marginal tax rate τ^G is computed by comparing the tax liability T when increasing posted income z by SEK 1,000, i.e., $\tau^G = [T(z + 1,000) - T(z)]/1,000$.

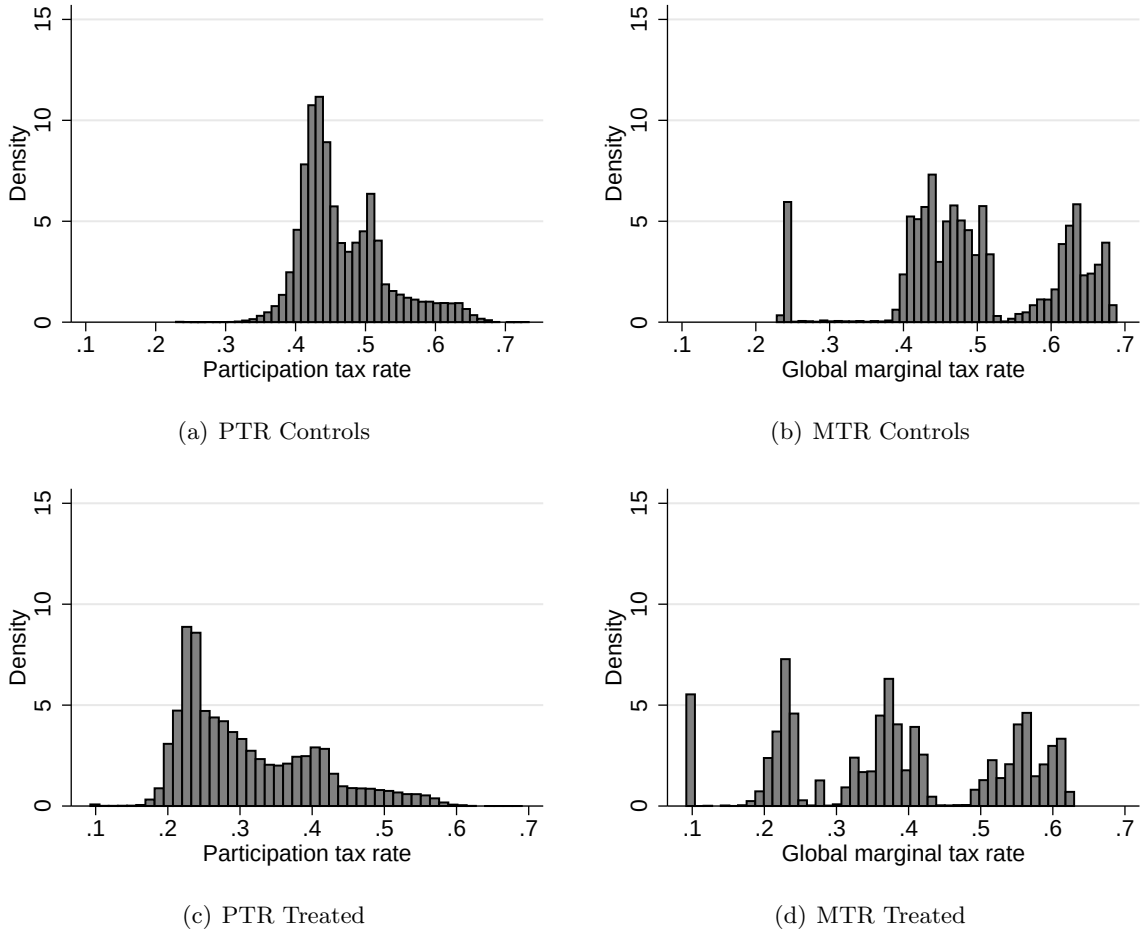
To give a sense of the identifying variation, Figure 3 shows the average participation tax rate and the average global marginal income tax rate in the treatment and control groups during 2001–2010. The reform in 2007 led to substantial decreases in the tax rates for the treatment group, whereas the decreases in the control group were much smaller. During the post-reform period, the average participation and global marginal income tax rate have been 10–15 percentage points lower in the treatment group compared to the control group. Figure 4 shows the distributions of the participation tax rate and the global marginal income tax rate in the treatment and control groups, combined during the post-reform period 2007–2010. The distributions for the treatment group are much to the left of the distributions for the control group for both the participation tax rate and the global marginal income tax rate.



(a) Average participation tax rate

(b) Average global marginal income tax rate

Figure 3: Variation in tax rates by treatment status, 2001–2010



(a) PTR Controls

(b) MTR Controls

(c) PTR Treated

(d) MTR Treated

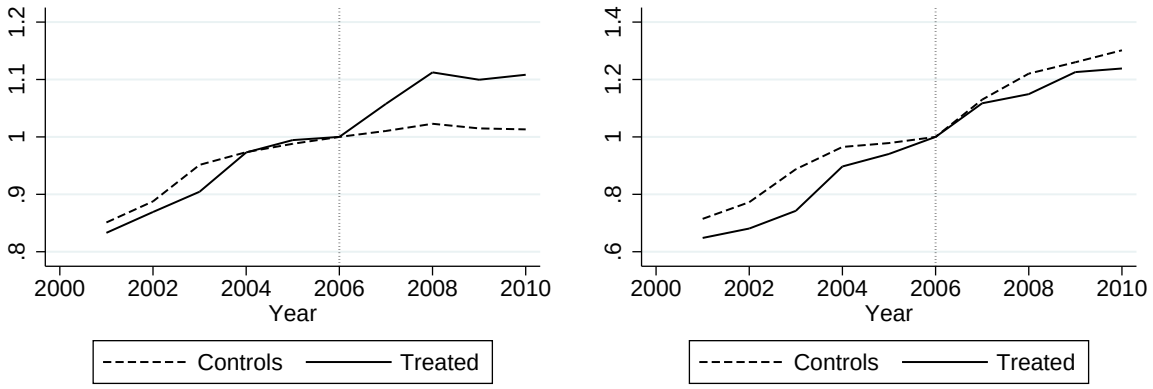
Figure 4: Participation tax rate (PTR) and global marginal income tax rate (MTR) by treatment status, combined over the post-reform period 2007–2010

5 Results

5.1 Graphical Analysis

Figure 5 shows the development of employment and taxable labor income in the control and treatment groups during 2001–2010. The treatment group consists of a cross-section of individuals who turned 65 during October–December the year before, while the control group consists of a cross-section of individuals who turned 65 during January–March the same year. The vertical line indicates the last pre-reform year. Employment and income levels in year 2006 are normalized to 100 for all groups.

Figure 5(a) shows that the employment trends of the treatment and control groups are parallell in the years prior to the reform. The jump in employment in the control group in 2003 and in the treatment group in 2004 is a cohort effect that is likely due to the fact that the 1938 cohort was the first cohort to receive pension from the new public pension system. As described in section 2.2, the 1938 cohort immediately received 4/20 of their pension from the new public pension system, whereas the phase-in for each successive cohort was lower with an additional 1/20 of their pension benefits from the new scheme. In 2007, after the introduction of the age-targeted tax credits, there is a clear trend break in employment, which provides evidence of an employment effect of the reform. Figure 5(b) shows a less clear development of taxable labor income over time. The series for the treatment and control groups are less parallell in the pre-reform years and there is no evident trend break at the time of the reform.



(a) Employment

(b) Taxable labor income

Figure 5: Employment and income index in the treatment and control groups, 2001–2010

5.2 Main Results

Table 2 presents the main results. The first three columns show the results for employment and the last three columns show the results for taxable labor income. The first and fourth column presents the results from difference-in-differences estimation of equations (1) and (2), without group-specific time trends. They show an employment elasticity with respect to the net-of-participation-tax rate of about 0.19 and a taxable labor income elasticity with respect to the global marginal net-of-tax rate of about 1.1. To assess the parallel trends assumption, I

perform a t-test for the presence of a linear time trend in the pre-reform period. The p-values from the parallel trends tests suggest that the null hypothesis of parallel trends in the outcome variable prior to 2007 cannot be rejected for employment, but can be rejected for taxable labor income.

The second and the fifth column adds group-specific linear time trends to the two models, as was presented in equations (3) and (4). As expected, since the parallel trends assumption could not be rejected for the employment outcome, the employment elasticity estimate changes only a little, from 0.19 to 0.16, when this complexity is added to the model. For taxable labor income, however, where the assumption of parallel trends prior to the reform was clearly rejected, the addition of group-specific linear time trends completely changes the result. Instead of a significant elasticity of 1.1, the model with time trends yields an elasticity estimate that is not statistically significantly different from zero. In the third and the sixth column, socioeconomic control variables are added to the model with group-specific linear time trends. This has no impact on the estimated effects, still yielding a participation elasticity of 0.16 and an elasticity of taxable income that cannot be statistically significantly separated from zero. These results are in line with the graphical evidence presented in Figure 5, that indicated an employment effect but no clear effect on taxable labor income.

Table 2: Main results

	Employment			Taxable labor income		
	(1)	(2)	(3)	(4)	(5)	(6)
Net-of-participation-tax rate elasticity	0.192***	0.158***	0.158***			
	(0.019)	(0.037)	(0.036)			
Global marginal net-of-income-tax rate elasticity				1.094***	-0.127	-0.124
				(0.109)	(0.194)	(0.187)
Post reform	0.016***	-0.031***	-0.037***	0.259***	0.021	-0.010
	(0.004)	(0.008)	(0.008)	(0.018)	(0.031)	(0.031)
Treated	-0.179***	-2.995	-3.442	-0.382***	-82.998***	-84.678***
	(0.003)	(2.695)	(2.642)	(0.017)	(11.395)	(10.959)
Year		0.010***	0.010***		0.069***	0.071***
		(0.001)	(0.001)		(0.003)	(0.003)
Treated*Year		0.001	0.002		0.041***	0.042***
		(0.001)	(0.001)		(0.006)	(0.005)
Constant	0.858***	-19.805***	-20.147***	11.770***	-128.180***	-132.142***
	(0.015)	(1.675)	(1.640)	(0.091)	(6.896)	(6.642)
Observations	238,429	238,429	238,429	158,593	158,593	158,593
Control variables	No	No	Yes	No	No	Yes
p-val parallel trends test	0.297			0.000		

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Controls include gender, education, immigrant status, self-employment status, sickness status, spousal employment status and county in the baseline year $t-3$.

The estimated elasticities can be compared to results in the previous literature. Hotz 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 between 0.69 and 1.69 among single women with children, which was the group primarily affected by the EITC. 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. Chetty, Guren, Manoli, and Weber (2012) summarize the evidence on participation responses to pension benefits and find an extensive margin elasticity of about 0.26. Saez, Slemrod, and Giertz (2012) review the evidence on intensive margin elasticities in the elasticity of taxable income literature. In the recent literature, controlling appropriately for pre-reform income, there is a range of elasticity estimates that all are fairly close to zero. Chetty (2012) study the importance of optimization frictions. He finds that the mean elasticity of 0.12 increases to about 0.3 when optimization frictions are taken into account. He also argues that extensive and intensive margin are more similar than what has typically been found, estimating a mean value of the extensive margin elasticity of 0.25.

The results for the participation elasticity in this study is at the lower end of the distribution of estimates in the previous literature. The zero intensive margin elasticity, although with large standard errors, is not an unusual result compared to what has typically been found. Since no previous study has analyzed behavioral responses to taxation for workers at the margin of retirement, it is a priori unclear what to expect for this group. The fact that there is a statistically significant effect on employment is indeed interesting even if it is small compared to the responsiveness of some other population groups.

There are a number of caveats to the analysis. First, the control group will eventually 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. 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 behavioral effects will be attenuated. In addition, only the short-term effects during the year immediately following the 65th birthday are being analyzed. There may also be long-term changes that are not accounted for in this study. The analysis also does not account for any indirect effects on retirement through changes in social norms. This is something that is hard to measure. A point highlighted by Liebman (1998) and Chetty and Saez (2013) 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. Still, more information about the tax credits could potentially lead to a larger responsiveness.

5.3 Heterogeneous Responses

To shed further light on the estimates found in the main analysis, I present results from separate estimations for different groups of the population. All results are based on the estimation of equations (3) and (4) with group-specific time trends and include socioeconomic control variables. Following the notation in Saez (2002) that was used in Section 3, I first estimate the effects for groups of workers with different skill levels, h_i. I define the groups based on the quintile of labor earnings in year $t-3$. The results, presented in Table 3, show that the elasticity varies across income quintile groups. It is largest for income quintile 2 and 3, at above 0.25, and about 0.13 for income quintile 1 and 4, although not quite significant. For the highest income quintile, the employment elasticity is estimated to be very close to zero. At the intensive margin

there is a significant elasticity of taxable income above 1 for the lowest quintile, but the standard errors are large. For the other income quintile groups, there is no evidence of a positive intensive margin elasticity.

Table 3: Results by earnings quintile in year $t-3$

	(1) Q1	(2) Q2	(3) Q3	(4) Q4	(5) Q5
Employment					
Net-of-participation-tax rate elasticity	0.138	0.278***	0.247***	0.134*	-0.004
	(0.094)	(0.074)	(0.080)	(0.081)	(0.076)
Observations	45,588	48,203	48,210	48,211	48,217
Taxable labor income					
Global marginal net-of-income-tax rate elasticity	1.155**	-0.029	-0.676	-0.051	-0.392
	(0.460)	(0.476)	(0.456)	(0.365)	(0.321)
Observations	25,996	28,679	31,767	34,560	37,591

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Controls include treatment status indicator, post reform indicator and group-specific time trends, as well as gender, education, immigrant status, self-employment status, sickness status, spousal employment status and county in the baseline year $t-3$. The log net-of-participation-tax rate and the log marginal global net-of-tax rate are instrumented with the post reform and treatment group interaction.

Table 4 presents the results for other groups of the population. The upper panel shows the results for employment and the lower panel shows the results for taxable labor income. As a benchmark, the first column shows the results for the full sample as presented in the third and sixth column in Table 2. The second column in Table 4 shows the results for women. Labor supply studies of prime-aged workers typically find that responses are larger among women than men. Also in this setting, for workers at the margin of retirement, there are indications of a larger elasticity for women. The difference is small, however, and the standard errors are large. In terms of the elasticity of taxable labor income, the labor supply elasticity for women is still statistically insignificant.

Table 4: Results: Heterogeneity

	(1) Full sample	(2) Women	(3) Self-employed	(4) No college	(5) Healthy	(6) Spouse employed
Employment						
Net-of-participation-tax rate elasticity	0.158***	0.175***	-0.025	0.163***	0.175***	0.139***
	(0.036)	(0.052)	(0.122)	(0.043)	(0.041)	(0.053)
Observations	238,429	113,898	13,488	169,866	182,458	112,596
Taxable labor income						
Global marginal net-of-income-tax rate elasticity	-0.124	-0.443	2.422***	-0.356	-0.188	-0.038
	(0.187)	(0.289)	(0.851)	(0.223)	(0.203)	(0.259)
Observations	158,593	72,625	11,269	108,534	125,437	76,830

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Controls include treatment status indicator, post reform indicator and group-specific time trends, as well as gender, education, immigrant status, self-employment status, sickness status, spousal employment status and county in the baseline year $t-3$. The log net-of-participation-tax rate and the log marginal global net-of-tax rate are instrumented with the post reform and treatment group interaction.

The third column in Table 4 presents the results for workers who were self-employed in year $t-3$. It shows that the employment effect is completely driven by wage earners. Among

self-employed, there is no significant employment effect. This may be surprising, given that self-employed are particularly autonomous in their labor supply decision and are little constrained by institutional factors. Contrary to the results for employment, however, self-employed respond more strongly than wage earners in terms of taxable labor income. The intensive margin elasticity for self-employed is very large, at 2.4, but the standard errors are also large. The estimate is well above zero, however, and self-employed seem to be the only group responding to the tax credits at the intensive margin.

The fourth column shows the results for workers with no college education. Previous studies have shown that low educated may be more responsive to tax changes. The result for employment indicates that low educated workers responded slightly more than high educated workers to the age-targeted tax credits. Again, there is no significant effect at the intensive margin. It also seems reasonable to expect that healthier individuals would respond more to the age-targeted tax credits. The fifth column estimates the effect for individuals who did not collect sickness or disability benefits from the Social Insurance Agency in the baseline year $t-3$. The responses to the age-targeted tax credits are indeed concentrated among the healthier individuals. There are still no effects at the intensive margin.

Finally, several studies have documented a strong correlation in the timing of retirement between spouses, suggesting an additional value of joint retirement.[11] The sixth column presents the results for individuals whose spouse was employed in the baseline year $t-3$. The employment elasticity for this group is in fact smaller than for the full sample, which gives no support for joint retirement being important for the responsiveness to the age-targeted tax credits. This can be driven, however, by the fact that the elasticity for men was lower than for women, and that men are more likely to have younger spouses who were still employed. Unfortunately, since the employment of the spouse in year t is endogenous to the age-targeted tax credits, it is difficult to investigate this issue further.

5.4 Robustness Checks

To make sure that the results are robust, I perform a series of tests. Table 5 presents the results for alternative cutoffs, outcomes and samples. The first column shows the results for an alternative cutoff value of employment, namely an income above the 2007 tax liability threshold of SEK 17,100 instead of above zero as in the main analysis. It should be noted that the tax liability threshold includes all types of income, also transfer income. Therefore, individuals pay taxes on labor income below this threshold if they have any other income and most individuals in the analysis collect public pension. The estimated elasticity for the alternative cutoff value for employment is in the same range as the previous results, at about 0.13.

The second and fifth columns in Table 5 show the results for an alternative outcome measure from another data source, namely the number of months worked as reported by employers. Also for this measure, there is a significant employment elasticity in the same range as for the definition based on taxable labor income, at about 0.13. At the intensive margin, there is even a negative elasticity but it is only marginally significant at the ten percent level. To make sure that the results are robust to other sample selections, columns 3, 4, 6 and 7 in Table 5 present

[11] See, e.g., Hurd (1990), Baker (2002), Schirle (2008) and Zweimüller, Winter-Ebmer, and Falkinger (1996).

Table 5: Robustness: Alternative cutoffs, outcomes and samples

	Employment				Taxable labor income		
	(1) Employment cutoff: $> 17,100$ SEK	(2) Outcome: Remune-rated months	(3) Sample: 4 months around year-end	(4) Sample: 2 months around year-end	(5) Outcome: Remune-rated months	(6) Sample: 4 months around year-end	(7) Sample: 2 months around year-end
Net-of-participation-tax rate elasticity	0.132***	0.132***	0.132***	0.159***			
	(0.038)	(0.037)	(0.031)	(0.045)			
Global marginal net-of-income-tax rate elasticity					-0.167*	-0.134	-0.214
					(0.097)	(0.159)	(0.235)
Observations	238,429	238,429	325,142	153,164	145,170	215,916	101,722

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Controls include treatment status indicator, post reform indicator and group-specific time trends, as well as gender, education, immigrant status, self-employment status, sickness status, spousal employment status and county in the baseline year $t-3$. The log net-of-participation-tax rate and the log marginal global net-of-tax rate are instrumented with the post reform and treatment group interaction.

the results for individuals with birthday within 2 or 4 months around the new year, instead of within 3 months as in the main analysis. The pattern of the results is similar for these sample selections, with a slightly lower employment estimate for the 4 months selection and a very similar employment estimate for the 2 months selection. Also at the intensive margin the results are similar, indicating an elasticity of taxable income that cannot be significantly separated from zero.

As discussed by Saez, Slemrod, and Giertz (2012), an alternative to using a cross-sectional difference-in-difference approach is to make use of the panel dimension in the data. Table 6 shows results from a panel model. As in much of the literature I consider changes over a 3-year interval, by stacking differences for years 1998 to 2001, 1999 to 2002, ..., 2007 to 2010.[12] I then estimate the two-stage-least-squares panel regressions:

$$P_{i,t} = e \cdot \Delta \log \tau^A_{i,t} + \alpha_t + \beta \cdot 1(i \in T) + \epsilon_{i,t}, \tag{5}$$

for extensive margin responses and

$$\Delta \log z_{i,t} = e \cdot \Delta \log \tau^G_{i,t} + \alpha_t + \beta \cdot 1(i \in T) + \epsilon_{i,t}, \tag{6}$$

for intensive margin responses. The post reform and treatment group interaction $1(t \geq \bar{t}) \cdot 1(i \in T)$ is again used as an instrument, this time for $\Delta \log \tau^A$ and $\Delta \log \tau^G$. Since the previous literature has been much concerned about controlling for base-year income, I follow Kleven and Schultz (2013) and consider the main pre-reform income controls that have been proposed in the literature: no income controls (Feldstein (1995)); log base-year $(t-3)$ income (Auten and Carroll (1999)); 10-piece spline in log base-year $(t-3)$ income (Gruber and Saez (2002)), and the combination of a 10-piece spline in log $t-4$ income and the log-deviation between $t-3$ and $t-4$ income (Kopczuk (2005)). However, since the treatment and control groups are not defined based on previous income, income controls are unlikely to be crucial.

[12]The fact that the last difference is between two post-reform years poses no problem in the estimation since the treatment group only faces a lower tax rate in the last year. It is only a concern if the labor supply response in the treatment group 3 years prior to age 65 is affected by the tax rate the individual will face at age 65. Such an endogenous response seems fairly unlikely, and if it exists, it will attenuate any reform effects.

Table 6: Robustness: Panel analysis

	Employment				Taxable labor income			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Net-of-participation-tax rate elasticity	0.158***	0.148***	0.145***	0.150***				
	(0.036)	(0.036)	(0.036)	(0.036)				
Global marginal net-of-income-tax rate elasticity					-0.143	-0.142	-0.140	-0.128
					(0.179)	(0.179)	(0.179)	(0.179)
Observations	238,429	238,429	238,429	238,429	158,593	158,593	158,593	158,593
Log $t-3$ income	No	Yes	No	No	No	Yes	No	No
Splines of log $t-3$ income	No	No	Yes	No	No	No	Yes	No
Splines of log $t-4$ income	No	No	No	Yes	No	No	No	Yes
Log deviation between $t-4$ and $t-3$ income	No	No	No	Yes	No	No	No	Yes
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Controls include treatment status indicator, post reform indicator and group-specific time trends, as well as gender, education, immigrant status, self-employment status, sickness status, spousal employment status and county in the baseline year $t-3$. The log net-of-participation-tax rate and the log marginal global net-of-tax rate are instrumented with the post reform and treatment group interaction.

The results from the panel model in Table 6 are very similar to the cross-section results in Table 2 both in terms of extensive and intensive margin responses. The estimate of the employment elasticity varies between 0.145 and 0.158 and remains statistically significant in all models. The taxable labor income elasticity does not change much compared to the cross-section model, still indicating an elasticity around zero. Overall, the specification tests suggest that the results found in the main analysis are robust.

5.5 Public Finance Implications

The main motivation for the age-targeted income tax credits was to increase the retirement age and raise additional taxes to offset the financial burden of an aging population. Although there are significant behavioral responses to the reform, also the reform cost in terms of foregone taxes is substantial. An important question for policy analysis is the degree of self-financing. To study the effects of the reform on public finances, I follow Saez (2002). He shows that the overall change in public sector finances from a tax change affecting the extensive margin labor supply can be decomposed into a "mechanical" and a "behavioral" component. Since I found significant responses at the extensive but not at the intensive margin, I only consider the participation margin in the calculations.

The mechanical component is the change in tax revenue for individuals who do not change their retirement behavior. Building on the notation in section 3, the mechanical decrease in tax revenue from extensive margin responses is equal to $h_i dT_i$. The behavioral component is the change in tax revenue from the changes in retirement behavior due to the reform. The behavioral response implies that the tax change induces dh_i workers to enter the labor force, and by definition of η_i in (3), we have $dh_i = -h_i \eta_i dT_i/(c_i - c_0)$. Since each worker entering the labor force increases tax revenue by $T_i - T_0$, the total behavioral benefit is equal to $-(T_i - T_0)h_i \eta_i dT_i/(c_i - c_0)$. The degree of self-financing is then given by the behavioral benefit as a share of the mechanical cost, which becomes $(T_i - T_0)\eta_i/(c_i - c_0)$. By letting this expression equal 1, we can further get the elasticity that would be required for the reform to be fully self-financing, which is given by the expression $(c_i - c_0)/(T_i - T_0)$.

One may assume that all tax decreases are used for consumption, which would imply that there are also other benefits of the reform in terms of value added tax payments. If so, the mechanical cost is equal to $h_i dT_i(1-\tau^V)$ and the behavioral benefit is equal to $-(T_i - T_0 + (c_i - c_0)\tau^V)h_i\eta_i dT_i/(c_i - c_0)$, where τ^V is the value added tax rate. The degree of self-financing is then given by $(T_i - T_0 + (c_i - c_0)\tau^V)\eta_i/[(c_i - c_0)(1-\tau^V)]$ and the elasticity required for full financing is given by $(c_i - c_0)(1-\tau^V)/[T_i - T_0 + (c_i - c_0)\tau^V]$.

Table 7 presents the results from the decomposition. The table shows the results for all individuals in the treatment group after the reform, i.e., individuals who turned 65 from October to December the previous year during 2007–2010 with year $t-3$ earnings above the 2007 tax liability threshold. 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 2010. I use the five groups i based on the quintile group of labor earnings in year $t-3$ that I defined in Section 5.3. The combined costs and benefits of the five groups are presented in column (6). The last column presents the results based on averages in the full sample, assuming that all types of workers would respond in the same way and entail the same costs and benefits.

Table 7: Public finance implications of the age-targeted tax credits

Labor income quintile in year $t-3$	(1) Q1	(2) Q2	(3) Q3	(4) Q4	(5) Q5	(6) Sum (1)-(5)	(7) Full sample
h_i	892	973	1,062	1,259	1,472		5,658
η_i	0.138	0.278	0.247	0.134	-0.004		0.158
dT_i	-11,498	-18,025	-29,529	-41,268	-68,391		-31,330
$c_i - c_0$	48,253	74,828	96,483	118,843	184,347		104,554
$T_i - T_0$	23,830	32,199	41,040	58,294	153,879		68,556
Mechanical cost (million)	-10.3	-17.5	-31.4	-52.0	-100.7	-211.8	-177.3
Behavioral benefit (million)	0.698	2.098	3.293	3.421	-0.342	9.168	18.4
Degree of self-financing	0.068	0.120	0.105	0.066	-0.003	0.043	0.104
η_i required for full financing	2.025	2.324	2.351	2.039	1.198		1.525
Mechanical cost w/ VAT (million)	-8.1	-13.9	-24.8	-41.0	-79.5	-167.3	-140.0
Behavioral benefit w/ VAT (million)	0.995	3.122	4.919	4.886	-0.428	13.494	24.3
Degree of self-financing w/ VAT	0.123	0.225	0.199	0.119	-0.005	0.081	0.174
η_i required for full financing w/ VAT	1.122	1.234	1.243	1.128	0.756		0.913

Individuals turning 65 Nov–Dec 2007–2010 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.

The upper panel of Table 7 presents the statistics used in the calculations. h_i is the number of employed workers in 2006, before the reform was implemented. It increases steadily by income quintile. η_i is the elasticity from estimating equation (3) with socioeconomic control variables, separately for each income quintile group. As was already seen in Table 3, the elasticity varies across income quintile groups. It is largest for income quintile 2 and 3, lower for income quintile 1 and 4, and very close to zero for income quintile 5. The statistics dT_i, $c_i - c_0$ and $T_i - T_0$ are calculated as the average in the treatment group, combined over the post-reform period 2007–2010. dT_i is the change in taxes paid due to the implementation of the tax credits, $c_i - c_0$ is the difference in net earnings if working or not working, and $T_i - T_0$ is the difference in taxes paid if working and not working.

The middle panel of Table 7 presents the results of the public finance calculations without

taking value added taxes into account. Whereas the mechanical cost increases with income quintile since both employment and earnings increase along this dimension, the behavioral benefit also depends on the elasticity estimates for the different income quintiles. In general, the behavioral benefits are far from compensating for the mechanical costs within the income quintiles. When summing over all income quintiles, the degree of self-financing is as low as 4.3 percent. If assuming a homogeneous response along the income distribution, which the estimates of η_i does not support, the degree of self-financing increases to about 10 percent. The costs of the earned income tax credit and the payroll tax credit are large, and the behavioral changes are far too small to account for the mechanical costs of the tax credits. The last row in the middle panel shows that the elasticities that would be required for the benefits from the behavioral component to fully finance the costs of the mechanical component of the reform are well above one, and often above two. This is arguably very large compared to what has been found in the previous literature.

The lower panel of Table 7 presents the results of the public finance calculations assuming that all net income is used for consumption, which would give extra benefits in terms of value added tax payments. Following Pirttilä and Selin (2011), I use an effective value added tax rate of 21 percent. This slightly increases the degree of self-financing to 6.4 percent when accounting for differences along the income distribution, and to 13.7 percent for the full sample. The elasticities needed for the reform to be fully financed are still fairly large, between one and two.

The caveats to the analysis that were discussed in Section 5.2 still apply. Since the tax credits will accrue to the reform group with a delay, one year later than to the treatment group, the estimated behavioral effects may be attenuated. The responsiveness to the reform may also increase over time if knowledge about the tax credits improves. Furthermore, a full analysis would take into account the costs and benefits for all individuals affected by the reform, not just those in the narrowly defined treatment group. In addition to these caveats, the analysis does not take welfare, but only public finance considerations, into account. Given the very low degree of self-financing of the reform, however, it is difficult to imagine that any changes to the analysis would alter the conclusion that the reform is far from fully financed.

6 Conclusion

I study the impact of income tax policy changes on retirement behavior. I make use of an earned income tax credit and a payroll tax credit targeted at workers above age 65, introduced in Sweden in 2007. The results suggest a positive effect of the age-targeted tax credits at the extensive margin, but no effect at the intensive margin. In the year immediately following the 65th birthday, the elasticity of employment with respect to the net-of-participation-tax rate was estimated to 0.15–0.2 whereas the elasticity of taxable labor income with respect to the global marginal net-of-tax-rate was estimated to zero.

The paper shows that changing the tax incentives around the retirement age is one way to promote a delayed labor force exit. Although perhaps less politically controversial than pension reform, however, it appears to be an expensive strategy. The estimated elasticities are small compared to the previous literature, and calculations show that the behavioral benefits from the reform are far too small to compensate for the mechanical costs of reduced tax rates. In fact, a

fully financed reform would require unusually large elasticities compared to what has typically been found in the literature.

References

Aaberge, R., and L. Flood (2008): "Evaluation of an In-Work Tax Credit Reform in Sweden: Effects on Labor Supply and Welfare Participation of Single Mothers," IZA Discussion Paper 3736, Institute for the Study of Labor.

Auten, G., and R. Carroll (1999): "The Effect of Income Taxes on Household Behavior," *Review of Economic Literature*, 49, 3–71.

Baker, M. (2002): "The Retirement Behavior of Married Couples. Evidence from the Spouse's Allowance," *Journal of Human Resources*, 37, 1–34.

Banks, J., and P. Diamond (2010): "The Base for Direct Taxation," in *Dimensions of Tax Design*, ed. by S. Adam, T. Besley, R. Blundell, S. Bond, R. Chote, M. Gammie, P. Johnson, G. Myles, and J. Poterba, pp. 548–674. Oxford University Press, Oxford.

Blundell, R., and H. Hoynes (2004): "Has 'In-Work' Benefit Reform Helped the Labor Market?," in *Seeking a Premier Economy: The Economic Effects of British Economic Reforms 1980–2000*, ed. by D. Card, R. Blundell, and R. Freeman, pp. 411–460. The University of Chicago Press, Chicago.

Brown, K. (2013): "The Link between Pensions and Retirement Timing: Lessons from California Teachers," *Journal of Public Economics*, 98, 1–14.

Chetty, R. (2012): "Bounds on Elasticities with Optimization Frictions: A Synthesis of Micro and Macro Evidence on Labor Supply," *Econometrica*, 80, 969–1018.

Chetty, R., A. Guren, D. Manoli, and A. Weber (2012): "Does Indivisible Labor Explain the Difference between Micro and Macro Elasticities? A Meta-Analysis of Extensive Margin Elasticities," *NBER Macroeconomics Annual*, 27, 1–56.

Chetty, R., and E. Saez (2013): "Teaching the Tax Code: Earnings Responses to an Experiment with EITC Recipients," *American Economic Journal: Applied Economics*, 5, 1–31.

Edmark, K., C. Liang, E. Mörk, and H. Selin (2012): "Evaluation of the Swedish Earned Income Tax Credit," IFAU Working Paper 2012:1, Institute for Evaluation of Labour Market and Education Policy.

Eissa, N., and H. Hoynes (2006): "Behavioral Responses to Taxes: Lessons from the EITC and Labor Supply," in *Tax policy and the economy 20*, ed. by J. Poterba. MIT Press, Cambridge.

Ericson, P., and L. Flood (2009): "A Microsimulation Approach to an Optimal Swedish Income Tax," IZA Discussion Paper 4379, Institute for the Study of Labor.

Feldstein, M. (1995): "The Effect of Marginal Tax Rates on Taxable Income: A Panel Study of the 1986 Tax Reform Act," *Journal of Political Economy*, 103, 551–572.

Fredriksson, P., and B. Öckert (2013): "Life-Cycle Effects of Age at School Start," *The Economic Journal*, 124, 977–1004.

French, E. (2005): "The Effects of Health, Wealth, and Wages on Labour Supply and Retirement Behaviour," *Review of Economic Studies*, 72, 395–427.

Gruber, J., and E. Saez (2002): "The Elasticity of Taxable Income: Evidence and Implications," *Journal of Public Economics*, 84, 1–32.

Gruber, J., and D. Wise (1999): *Social Security and Retirement Around the World*. University of Chicago Press, Chicago.

Hotz, V., and J. Scholz (2003): "The Earned Income Tax Credit," in *Means-Tested Transfer Programs in the United States*, ed. by R. Moffitt. University of Chicago Press, Chicago.

Hurd, M. (1990): "The Joint Retirement Decision of Husbands and Wives," in *Issues in the Economics of Aging*, ed. by D. Wise. University of Chicago Press, Chicago.

Immervoll, H., H. Kleven, C. Kreiner, and E. Saez (2007): "Welfare Reform in European Countries: A Microsimulation Analysis," *Economic Journal*, 117, 1–44.

Johansson, P., L. Laun, and M. Palme (2014): "Pathways to Retirement and the Role of Financial Incentives in Sweden," NBER Working Paper 20123, National Bureau of Economic Research.

Kleven, H., and E. Schultz (2013): "Estimating Taxable Income Responses Using Danish Tax Reforms," *American Economic Journal: Economic Policy*, forthcoming.

Kopczuk, W. (2005): "Tax Bases, Tax Rates, and the Elasticity of Reported Income," *Journal of Public Economics*, 89, 2093–2119.

Laun, T., and J. Wallenius (2014): "A Life Cycle Model of Health and Retirement: The Case of Swedish Pension Reform," *Journal of Public Economics*, forthcoming.

Lehmann, E., F. Marical, and L. Rioux (2013): "Labor Income Respond Differently to Income-Tax and to Payroll-Tax Reforms," *Journal of Public Economics*, 99, 66–84.

Liebman, J. (1998): "The Impact of the Earned Income Tax Credit on Incentives and Income Distribution," *Tax Policy and the Economy*, 12, 83–119.

Lindsey, L. (1987): "Individual Taxpayer Response to Tax Cuts: 1982-1984. With Implications for the Revenue Maximizing Tax Rate," *Journal of Public Economics*, 33, 173–206.

Manoli, D., and A. Weber (2011): "Nonparametric Evidence on the Effects of Financial Incentives on Retirement Decisions," NBER Working Paper 17320, National Bureau of Economic Research.

Meghir, C., and D. Phillips (2010): "Labour Supply and Taxes," in *Dimensions of Tax Design*, ed. by S. Adam, T. Besley, R. Blundell, S. Bond, R. Chote, M. Gammie, P. Johnson, G. Myles, and J. Poterba, pp. 202–274. Oxford University Press, Oxford.

Ministry of Finance (2012): "Utvärdering av jobbskatteavdraget," Prop. 2011/12:100, bilaga 5, Swedish Ministry of Finance.

Pirttilä, J., and H. Selin (2011): "Tax Policy and Employment: How Does the Swedish System Fare?," Working Paper 2011:2, Department of Economics, Uppsala University.

Riksrevisionen (2009): "Jobbskatteavdraget," RiR 2009:20, Riksrevisionen.

Sacklén, H. (2009): "Arbetsutbudseffekter av reformer på inkomstskatteområdet 2007–2009," Report, Swedish Ministry of Finance.

Saez, E. (2002): "Optimal Income Transfer Programs: Intensive versus Extensive Labor Supply Responses," *The Quarterly Journal of Economics*, 117, 1039–1073.

Saez, E., J. Slemrod, and S. Giertz (2012): "The Elasticity of Taxable Income with Respect to Marginal Tax Rates: A Critical Review," *Journal of Economic Literature*, 50, 3–50.

Schirle, T. (2008): "Why Have the Labor Force Participation Rates of Older Men Increased since the Mid-1990s?," *Journal of Labor Economics*, 26, 549–594.

Zweimüller, J., R. Winter-Ebmer, and J. Falkinger (1996): "Retirement of Spouses and Social Security Reform," *European Economic Review*, 40, 449–472.

Appendix

A Tax Simulation Details

Table A-1: Central government income tax breakpoints, SEK, 1997–2010

Year	20 % tax rate	25 % tax rate
1997	-	231,600
1998	-	238,400
1999	245,000	389,500
2000	254,700	398,600
2001	271,500	411,100
2002	290,100	430,900
2003	301,000	447,200
2004	308,800	458,900
2005	313,000	465,200
2006	317,700	472,300
2007	328,600	488,600
2008	340,900	507,100
2009	380,200	538,800
2010	384,600	545,200

Table A-2: Formula for the standard deduction, 1997–2010

Income, pbb	Standard deduction, pbb
Year 1997–2000	
≤ 1.86	0.24
1.86–2.89	$0.24 + (z - 1.86) \times 0.25$
2.89–3.04	0.4975
3.04–5.615	$0.4975 - (z - 3.04) \times 0.1$
> 5.615	0.24
Year 2001	
≤ 1.86	0.27
1.86–2.89	$0.27 + (z - 1.86) \times 0.25$
2.89–3.04	0.5275
3.04–5.615	$0.5275 - (z - 3.04) \times 0.1$
> 5.615	0.27
Year 2002	
≤ 1.86	0.403
1.86–2.89	$0.403 + (z - 1.86) \times 0.25$
2.89–3.04	0.6605
3.04–3.66	$0.6605 - (z - 3.04) \times 0.1$
3.66–5.615	$0.5985 - (z - 3.66) \times 0.14$
5.615–6.41	$0.3248 - (z - 5.615) \times 0.04$
> 6.41	0.293
Year 2003–2004	
≤ 1.49	0.423
1.49–2.72	$0.423 + (z - 1.49) \times 0.2$
2.72–3.10	0.67
3.10–6.87	$0.67 - (z - 3.10) \times 0.1$
> 6.87	0.293
Year 2005	
≤ 1.185	0.423
1.185–2.72	$0.423 + (z - 1.185) \times 0.2$
2.72–3.11	0.73
3.11–7.48	$0.73 - (z - 3.11) \times 0.1$
> 7.48	0.293
Year 2006–2010	
≤ 0.99	0.423
0.99–2.72	$0.423 + (z - 0.99) \times 0.2$
2.72–3.11	0.77
3.11–7.88	$0.77 - (z - 3.11) \times 0.1$
> 7.88	0.293

pbb is the price base amount determined by the government each year and z is the posted labor income in price base amounts.

Table A-3: Formula for the additional standard deduction above age 65, 2009–2010

Income, pbb	Standard deduction, pbb
Year 2009	
≤ 0.99	0.425
0.99–2.72	$0.623 - z \times 0.2$
2.72–2.94	0.078
2.94–3.11	$0.372 - z \times 0.1$
3.11–7.88	0.061
7.88–8.49	$0.849 - z \times 0.1$
> 8.49	0
Year 2010	
≤ 0.99	0.5094
0.99–2.72	$0.7074 - z \times 0.2$
2.72–3.11	0.1624
3.11–3.9	$z \times 0.1 - 0.1486$
3.9–7.88	$0.2219 + z \times 0.005$
7.88–9.1568	$1.0099 - z \times 0.095$
> 9.1568	0.14

pbb is the price base amount determined by the government each year and z is the posted labor income in price base amounts.

Table A-4: Formula for the earned income tax credit below age 65, 2007–2010

Income, pbb	Earned income tax credit, pbb
Year 2007	
≤ 0.79	$(z - sd) \times t$
0.79–2.72	$(0.79 + (z - 0.79) \times 0.2 - sd) \times t$
> 2.72	$(1.176 - sd) \times t$
Year 2008	
≤ 0.91	$(z - sd) \times t$
0.91–2.72	$(0.91 + (z - 0.91) \times 0.2 - sd) \times t$
2.72–7	$(1.272 + (z - 2.72) \times 0.033 - sd) \times t$
> 7	$(1.413 - sd) \times t$
Year 2009	
≤ 0.91	$(z - sd) \times t$
0.91–2.72	$(0.91 + (z - 0.91) \times 0.25 - sd) \times t$
2.72–7	$(1.363 + (z - 2.72) \times 0.065 - sd) \times t$
> 7	$(1.642 - sd) \times t$
Year 2010	
≤ 0.91	$(z - sd) \times t$
0.91–2.72	$(0.91 + (z - 0.91) \times 0.304 - sd) \times t$
2.72–7	$(1.461 + (z - 2.72) \times 0.095 - sd) \times t$
> 7	$(1.868 - sd) \times t$

pbb is the price base amount determined by the government each year, z is the posted labor income in price base amounts, sd is the standard deduction in price base amounts and t is the local government tax rate.

Table A-5: Formula for the earned income tax credit above age 65, 2007–2010

Income	Earned income tax credit
Year 2007	
≤ 1.59 pbb	$(z - sd) \times t$ pbb
1.59–2.72 pbb	$(1.59 + (z - 1.59) \times 0.2 - sd) \times t$ pbb
> 2.72 pbb	$(1.816 - sd) \times t$ pbb
Year 2008	
≤ 1.79 pbb	$(z - sd) \times t$ pbb
1.79–2.72 pbb	$(1.79 + (z - 1.79) \times 0.2 - sd) \times t$ pbb
2.72–7 pbb	$(1.976 + (z - 2.72) \times 0.033 - sd) \times t$ pbb
> 7 pbb	$(2.117 - sd) \times t$ pbb
Year 2009–2010	
$\leq 100,000$ SEK	$z \times pbb \times 0.2$ SEK
$100,000 - 300,000$ SEK	$(15,000 + z \times pbb \times 0.05)$ SEK
$> 300,000$ SEK	$30,000$ SEK

pbb is the price base amount determined by the government each year, z is the posted labor income in price base amounts, *sd* is the standard deduction in price base amounts and t is the local government tax rate.