Department of Economics
Working Paper 2017:12

Analyzing tax reforms using the Swedish Labour Income Microsimulation Model

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Working paper 2017:12
November 2017
ISSN 1653-6975

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7 November 2017

Abstract

Labour income taxation is a central policy topic because labour income makes up the majority of national income and most taxes are in the end taxes on labour. In order to quantify how behavioural responses of labour income earners affect tax revenue, the Swedish Labour Income Microsimulation Model (SLIMM) is constructed and used to evaluate tax reforms. The model simulates taxable income responses, participation responses and income effects. Elasticities are calibrated to match midpoints of estimates found in the quasiexperimental literature. SLIMM is solidly microfounded and uses administrative register data. The model is used to analyze changes to the earned income tax credit (EITC), municipal income taxes and the central government income tax paid by high-income earners. The simulations indicate that the EITC has increased employment by 128,000 and has a degree of self-financing of 21 percent. Almost half of the revenue increase from higher municipal tax rates would disappear due to behavioural responses. Tax cuts for the richest fifth of working Swedes are completely self-financing.

*Department of Economics and Uppsala Center for Fiscal Studies, Uppsala University. I thank Spencer Bastani, Per Engström, Johan Fall, Lennart Flood, Dan Johansson, Johanna McElwee, Katarina Nordblom, Håkan Selin, Mikael Stenkula, Helena Svaleryd and seminar participants at the Department of Economics, Uppsala University, for helpful comments and discussions. I am also grateful to Katarina Johansson and Daniel Kruse at Statistics Sweden for data assistance. Financial support from the Jan Wallander and Tom Hedelius Foundation is gratefully acknowledged.

1 Introduction

The crafting of tax policy is, at its heart, a tradeoff between efficiency and equity. Income taxes distort the individual's choice between work and leisure and thus cause deadweight losses. At the same time, income taxation is a tool for redistribution. To aid policymakers in this tradeoff, economists have devised methods of predicting how taxpayers will respond to tax reforms. Due to these behavioural responses, the actual revenue loss after a tax cut will usually be lower than in a mechanical calculation where taxpayer responses are ignored.[1]

In this paper I develop the Swedish Labour Income Microsimulation Model (SLIMM), which can be used to predict individuals' responses to income tax changes and quantify the effect of such responses on tax revenue. The model uses exogenous elasticities grounded in the quasiexperimental literature, which arguably features the most credible method of identifying behavioural elasticities. The distribution of labour income is obtained from a full-population administrative register. In SLIMM, taxpayers are assumed to maximize a utility function parameterized to generate intensive margin elasticities and income effects that are consistent with empirical evidence. Results are presented for three different scenarios corresponding to low, medium and high behavioural responses. Individuals are heterogeneous in skill, corresponding to earnings potential, and in fixed costs of work. The skill distribution is constructed in such a way that utility maximization subject to today's tax schedule yields the observed income distribution. The distribution of fixed costs is carefully calibrated to achieve reasonable employment rates and extensive margin elasticities in line with the literature.

This paper contributes to the literature by constructing, for the first time, a comprehensive microsimulation model for Swedish institutional conditions where elasticities are exogenous. In contrast, the only other microsimulation model available – a discrete hours labour supply model called SWEtaxben (described by Ericson et al., 2009) – generates behavioural elasticities within the model by estimating a utility function on the population of interest. A number of papers, e.g., Immervoll et al. (2007), analyze the effects of marginal changes to the tax schedule. SLIMM, in contrast, can also evaluate non-marginal tax reforms, because it imposes a functional form for the utility function. A survey of the tax policy reform literature is given in the next section.

An important component in the model is a detailed characterization of the effective marginal tax rates facing labour income earners, taking into account the income tax, the payroll tax, consumption taxes and social insurance benefits. While income and payroll taxes are given directly by law, consumption taxes and social benefits need to be estimated. Considering both national accounts aggregates and evidence from a household survey of consumption patterns, the consumption tax rate is set to 19 percent. Social insurance benefits are estimated by calculating an actuarially fair insurance premium for each type of social insurance, taking earnings ceilings into account. Employment rates and out-of-work benefits are estimated from register data for each skill level by regressing labour income on demographic characteristics and interpreting the thus predicted income variable as the skill level. The benefit system is not modelled in detail, implying that some uncertainty surrounds the results pertaining to tax reforms where large interactions with the benefit system can be expected.

[1] Among practitioners, it is common to use the terms 'static' and 'dynamic' instead of mechanical and behavioural, which are more common in the academic literature. Here I use the latter terminology.

SLIMM can be used for reform evaluation by hypothetically changing the tax system and letting individuals optimize given the new tax schedule. In this way, it is possible to calculate how much a tax cut is expected to increase employment and pay for itself through behavioural responses, measured as the degree of self-financing (DSF).[2]

The main focus of the paper is on three important aspects of the Swedish tax system: the earned income tax credit (EITC, *jobbskatteavdraget*), the municipal income tax and the central government income tax. The EITC is a centrally funded tax credit offered to labour income earners. It has been the subject of political debate in Sweden since it was introduced as the flagship reform of the centre-right alliance that was in power between 2006 and 2014. It is meant to increase labour force participation by increasing the return to market work. When using SLIMM to evaluate the EITC, the estimated employment effect is 128,000 – implying that employment is 2.6 percent larger than it would have been without the EITC – and the degree of self-financing is 21 percent. This is approximately in line with previous estimates. It is also interesting to analyze the introduction of an American-style EITC, i.e., a tax credit targeted at the poorer half of the working population. This is estimated to increase employment by 149,000, but some of this could be part-time or seasonal work. It would be quite costly as it is associated with a negative degree of self-financing. The estimated revenue shortfall is 44 billion Swedish kronor (SEK).[3]

The municipal income tax is an almost proportional tax paid by nearly all income earners. It is projected to increase over the coming years and the effects of this are of great policy interest. The DSF of a marginal change to the average municipal tax rate is 43 percent in SLIMM's medium scenario. This is higher than some previous estimates in the literature and implies that behavioural responses are an important consideration in the discussion of the need for further tax increases.

Lastly, the taxation of high-income earners is analyzed. In this income segment, extensive margin responses are likely to be less important, so intensive margin responses dominate. In line with previous estimates, I find that an abolition of the last five percent of the central government income tax, *värnskatten*, would have a very high degree of self-financing – 167 percent in the medium scenario. In addition, I calculate that abolishing the entire central government income tax – which would lower marginal tax rates by up to 25 percentage points – would also completely pay for itself through behavioural responses.

The paper is structured as follows. The next section surveys the literature on microsimulation for tax policy analysis. Section 3 describes the taxation of labour earnings in Sweden and calculates effective marginal tax rates. Section 4 surveys the literature that estimates taxable income and participation elasticities and income effects and motivates the elasticities used in the model. A technical description of SLIMM is given in section 5, which also describes the income data and the calibration of elasticities. In section 6, the model is used to evaluate in-work tax credits, municipal tax changes and tax cuts for high-income earners. Finally, section 7 comments on policy implications and concludes.

[2]The degree of self-financing is the behavioural revenue effect divided by the mechanical revenue impact. In the case of a tax hike, it shows the proportion of the revenue increase that disappears due to behavioural responses.

[3]The current exchange rate is 9 SEK/USD.

2 Literature review

The history of tax policy reform evaluation is closely connected to developments in the theory of labour supply and optimal taxation, as well as in microeconometrics. This section gives an overview of the literature, highlighting differences and similarities with the present paper. The results of earlier papers are discussed throughout section 6.

Early labour supply research, carried out during the 1970s and '80s, usually estimated labour supply functions on cross-section data using maximum likelihood; Keane (2011) provides a comprehensive survey. It is worth noting that this applied literature was often quite detached from the theoretical optimal taxation literature that developed in the tradition of Mirrlees (1971). The literature typically used small survey datasets to estimate how hours of work are affected when after-tax wages change. A particular challenge was the presence of piecewise linear tax schedules; Hausman (1985) shows how these were dealt with econometrically. Cogan (1981) and others then introduced fixed costs of work as a theoretical underpinning for the extensive margin of labour supply.

Equipped with a labour supply function, researchers could hypothetically change the tax system in order to perform reform evaluation, taking behavioural responses into account. One early example of this is Blomquist (1983), who estimated a labour supply function on a sample of prime-age Swedish men using maximum likelihood. He then calculated that replacing the existing progressive income tax with a proportional tax that collected the same amount of revenue would lower the deadweight loss from 19 to 4 percent of revenue. Blomquist & Hansson-Brusewitz (1990) estimate linear and quadratic labour supply functions on data from a survey containing 1,400 observations. Using these for reform evaluation, they conclude that reducing the top marginal tax rate by five percentage points, compared to the one prevailing in 1980, would increase revenue.

During the 1990s, the literature instead turned to the discrete choice approach, whereby individuals are allowed to choose between a handful of different hours of work. A utility function is estimated on the population of interest through maximum likelihood. Modelling the choice of hours as a discrete rather than continuous decision has some econometric advantages and allows the researcher to model the tax and benefit systems in a richer way. The individual is assumed to choose the number of hours that maximizes utility. Individuals are first made to optimize given the current tax schedule, and then given a counterfactual tax schedule. The difference is interpreted as the behavioural effect of the reform. See van Soest (1995) for an early reference and Aaberge & Colombino (2014) for a description of this and other classes of simulation models.

In Sweden, Lennart Flood and colleagues have constructed a microsimulation model of this type called SWEtaxben (see Ericson et al., 2009, for a description). This is also available as part of FASIT, a model maintained by Statistics Sweden and the Ministry of Finance. SWEtaxben is very rich in its modelling of the tax–benefit system and features intra-household linkages and substantial individual heterogeneity. Apart from hours responses, the model also simulates the flow in and out of five different states such as disability or unemployment benefit. The data source is the LINDA database, which contains register data on a random sample of 3.35 percent of Sweden's population. The hours of work variable is constructed indirectly from data on taxable income and full-time-equivalent wages. The most recent version of SWEtaxben is in effect a hybrid model as it also features hourly wage responses to marginal tax rates, where the elasticity has been estimated using the new tax responsiveness approach (see next paragraph); this is described by Ericson et al. (2015). SWEtaxben is the only comprehensive tax–benefit microsimulation model with behavioural responses that is available for policy evaluation in Sweden. Consequently, it has been used to analyze EITC expansions, municipal tax rate changes and other possible tax reforms (see section 6). The exact magnitude of behavioural responses depends on the dataset upon which the parameters are estimated. Ericson et al. (2009) report that average uncompensated elasticities are 0.05 for single men and 0.1 for married men. This is considerably lower than most studies in the new tax responsiveness literature surveyed in section 4.1 below.[4]

The quasi-experimental wave in economics also affected public economics from the mid-1990s onwards. In particular, Feldstein (1995) launched the new tax responsiveness literature (surveyed by Saez et al., 2012), whose main variable of interest is the elasticity of taxable income with respect to the net-of-tax rate. This literature departed from the earlier labour supply literature described above in two significant ways. First, it uses tax reforms as identifying variation rather than making strong assumptions about unobserved heterogeneity in order to estimate labour supply functions. Second, the outcome variable studied is taxable income instead of hours of work. This enables the econometrician to capture tax reporting and hourly wage responses, in addition to hours responses. Further, taxable income data is more readily available and focusing on taxable income makes reform evaluation easier, as taxable income is the tax base, by definition. In general, the new tax responsiveness literature finds larger elasticities than those estimated in the hours of work literature.

In a seminal contribution, Saez (2001) connected the new empirical literature with the optimal income taxation literature by showing how optimal tax rates can be computed from behavioural elasticities, the shape of the income distribution and normative social welfare weights on different income groups. Saez calculated the optimal tax schedule through numerical simulations. Instead of assuming a parametric form for the skill distribution, as most of the earlier literature had done, he calibrated the skill distribution such that individual optimization yields the actual observed income distribution. SLIMM is thus similar to Saez (2001) in this regard, although the income distribution is characterized through discrete bins in the present paper while Saez used a continuous distribution.

Many economists have expanded on and applied the Saez (2001) approach. One example is Immervoll et al. (2007), who examine welfare programmes in 15 European countries.[5] They divide the population into ten groups, ordered by earnings. They then calculate effective marginal and participation tax rates for each decile using EUROMOD, a tax–benefit simulation model. Earnings data is obtained from a sample of the population. The authors impose an intensive margin elasticity of 0.1 and a participation elasticity of 0.2 on average (declining from 0.4 to 0 over the quintiles of the income distribution). They consider only marginal policy changes, implying that they do not have to assume a particular utility function. The authors also introduce demographic heterogeneity within income groups and show that letting the participation response be concentrated among married women and single parents has a small effect on their conclusions. There are some similarities between this paper and Immervoll et al. (2007), for example the characterization of the income distribution in discrete bins and the use of exogenous elasticities. At

[4] Ericson et al. (2015) write: "An important ambition in the development of SWEtaxben has been to minimize the risk of exaggerated behavioral effects. It can be argued that these effects probably are biased downward, both with respect to the labor supply effects as well as on hourly wages."

[5] Eissa et al. (2008) use a similar method to evaluate the American EITC and also incorporate income effects.

the same time, SLIMM goes further by using 2,000 bins rather than 10, by considering income effects and by assuming a functional form for the utility function, allowing the evaluation of non-marginal tax reforms. SLIMM also uses full-population registers.

Although the present paper is concerned with policy evaluation, there are some commonalities with two papers in the optimal taxation literature. Kleven et al. (2009) consider an explicit utility function and distribution of fixed costs of work, like the present paper. However, they set up a two-earner model where the primary earner reacts only on the intensive margin and the secondary earner only on the extensive margin, thereby avoiding the interaction of the two margins. In addition, they abstract from income effects. SLIMM includes both income effects and the interaction between the intensive and extensive margins, implying that elasticities have to be numerically calibrated. Jacquet et al. (2013) run microsimulations for the United States that have some similarities with SLIMM: individuals are heterogeneous in skill and fixed costs of work, elasticities from the microeconometric literature are used and the distribution of fixed costs of work is calibrated so that employment rates are increasing by income and participation elasticities decreasing in an empirically plausible way. In addition, the skill distribution is calibrated assuming that the observed earnings distribution is the result of individual optimization. However, these authors use survey data on earnings rather than taxable income from registers. Income effects are also not considered.

In the United States, a few microsimulation models of the taxable income type are available, though often lacking a thorough technical documentation. The congressional Joint Committee on Taxation is responsible for scoring all tax bills. In doing so, it considers tax reporting responses with taxable income elasticities rising by income; it however holds GDP fixed and thus ignores possible real responses.[6] The Tax Foundation (2017) has constructed a Tax and Growth Model which assumes a Cobb-Douglas production function and a labour supply elasticity of 0.3. The Urban-Brookings Tax Policy Center (2015) has a comprehensive microsimulation model which includes taxable income responses. The Center uses a taxable income elasticity of 0.25, based on Saez et al. (2012).

Broadly speaking, SLIMM falls within the Saez (2001) tradition, in that it uses exogenous elasticities and focuses on taxable income rather than hours of work. Compared to the pre-1990 literature and the discrete choice approach, as represented by SWEtaxben, the main advantage is that the use of exogenous elasticities increases transparency, allows a connection with the quasi-experimental literature and enables robustness checks. Using taxable income rather than hours of work also reduces the risk of measurement error. A difference compared to many earlier papers is also that SLIMM calibrates the skill distribution so that individual optimization yields the observed income distribution, and that this is recalibrated if a different elasticity is used. However, a limitation is that SLIMM does not feature any heterogeneity in demographic characteristics and does not model the benefit system in detail. Therefore it describes the effective tax schedule less well for, e.g., low-income single mothers. SLIMM can only be used to simulate tax reforms and conclusions about tax reforms should be interpreted with some caution when large interactions with the benefit system can be expected.

[6] Joint Committee on Taxation (2015). According to the Tax Foundation (2017), the average taxable income elasticity used by the JCT is 0.19.

3 Labour income taxation in Sweden

This section gives a comprehensive account of the taxation of labour income in Sweden in 2017.[7] This is required in order to establish exactly to what extent the tax system drives a wedge between the social and private returns to work. The income tax, consumption taxes, employers' social contributions and social insurance benefits are characterized. Combining all these, it is possible to calculate the effective marginal tax schedule, which shows how much of one krona of employee compensation has been paid in total taxes once the money has been used for consumption by the worker. The tax laws are presented as they apply to people aged 20 to 64, as this is the sample used for simulations. Occupational pensions and other non-wage benefits are disregarded. Individuals are assumed to receive all their taxable income from labour. In the interest of simplicity and conservatism, it is assumed that the burden of taxes on capital are borne entirely by capital owners and thus that labour supply and similar responses do not affect such tax bases.[8]

SLIMM is primarily concerned with the effects of the tax system. Aspects of the transfer system, such as housing benefit and social assistance, could also affect the budget constraint facing workers. However, in practice these transfers have a small impact on effective marginal tax rates and are therefore ignored when modelling the intensive margin. This issue is discussed in section 5.5.

3.1 Income tax

Income tax liability is determined by the municipal tax, the central government tax, the basic deduction and the earned income tax credit (EITC). Denoting taxable income by z and the municipal tax rate by τ_m, the basic deduction and the EITC can be viewed as a composite general deduction for labour income defined by the following:

$$D(z) = \begin{cases} z & \text{if } z \leq 0.91\text{PBB} \\ 0.91\text{PBB} + 0.332(z - 0.91\text{PBB}) & \text{if } 0.91\text{PBB} < z \leq 2.94\text{PBB} \\ 1.584\text{PBB} + 0.111(z - 2.94\text{PBB}) & \text{if } 2.94\text{PBB} < z \leq 8.08\text{PBB} \\ 2.155\text{PBB} & \text{if } 8.08\text{PBB} < z \leq 13.54\text{PBB} \\ 2.155\text{PBB} - 0.03/\tau_m \times (z - 13.54\text{PBB}) & \text{if } 13.54\text{PBB} < z \leq 13.54\text{PBB} + 1.862\text{PBB} \times \tau_m/0.03 \\ 0.293\text{PBB} & \text{if } 13.54\text{PBB} + 1.862\text{PBB} \times \tau_m/0.03 < z. \end{cases}$$

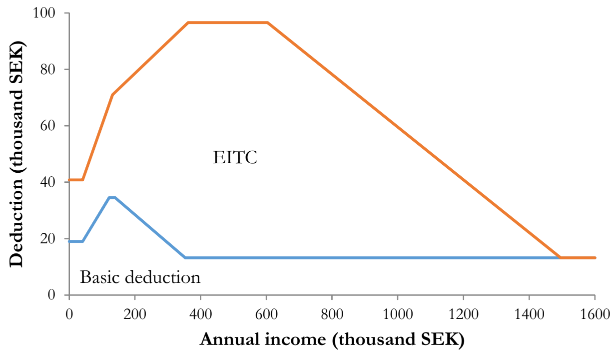
PBB (*prisbasbelopp*, price base amount) is linked to the CPI and is equal to SEK 44,800 in 2017. The function $D(z)$ is plotted in figure 1a.

Municipal tax is paid as a proportion on the part of taxable income that exceeds the composite general deduction $D(z)$. Municipal tax rates range from 29 to 35 percent. The average tax rate, which is used in the simulations, is 32.12 percent. In addition, central government income tax is 20 percent and 25 percent, respectively, for incomes exceeding certain thresholds. The last five percent of the central government income tax is unofficially known as *värnskatten*. About a fifth of labour income earners are subject to central government income tax. The income tax function is given by

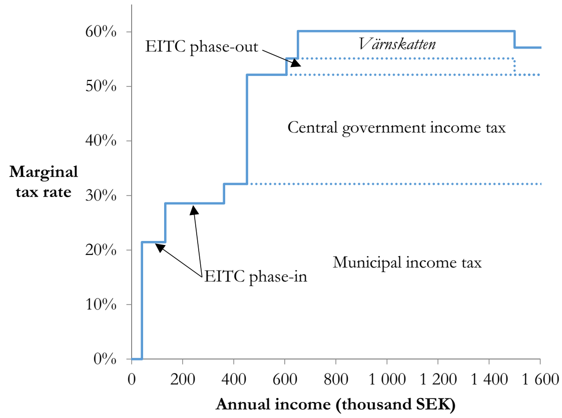
$$T_I(z) = \tau_m(z - D(z)) + \max\{0, 0.2(z - 452100)\} + \max\{0, 0.05(z - 651700)\}. \quad (1)$$

[7] Overviews of the Swedish tax system are also provided by Sørensen (2010) and Pirttilä & Selin (2011). For a historical perspective, see Du Rietz et al. (2015) or Bastani & Lundberg (2016).

[8] "The standard assumption about the corporate income tax that the burden falls 100% on capital remains the standard assumption even though it is commonly believed to be false (because of international capital mobility and endogenous saving)." (Fullerton & Metcalf, 2002, p. 1823)



(a) The part of income that is untaxed, comprised of the earned-income tax credit and the basic deduction.



(b) The marginal income tax schedule.

Figure 1: The Swedish income tax in 2017

This results in a marginal tax function of the following form:

$$T_I'(z) = \begin{cases} 0 & \text{if } z < 0.91\text{PBB} \\ \tau_m(1-0.332) & \text{if } 0.91\text{PBB} < z < 2.94\text{PBB} \\ \tau_m(1-0.111) & \text{if } 2.94\text{PBB} < z < 8.08\text{PBB} \\ \tau_m & \text{if } 8.08\text{PBB} < z < 452100 \\ \tau_m + 0.2 & \text{if } 452100 < z < 13.54\text{PBB} \\ \tau_m + 0.2 + 0.03 & \text{if } 13.54\text{PBB} < z < 651700 \\ \tau_m + 0.2 + 0.03 + 0.05 & \text{if } 651700 < z < 13.54\text{PBB} + 1.862\text{PBB} \times \tau_m/0.03 \\ \tau_m + 0.2 + 0.05 & \text{if } 13.54\text{PBB} + 1.862\text{PBB} \times \tau_m/0.03 < z. \end{cases} \tag{2}$$

This is plotted in figure 1b. The highest marginal tax rate is 60 percent. This is is the result of the municipal income tax (32 percent), the central government income tax (25 percent) and the EITC phase-out (3 percent).

3.2 Consumption taxes

The purpose of earning labour income is consumption. Thus consumption taxes need to be considered when computing the total tax wedge. However, computing the average effective consumption tax rate is not trivial.

The main VAT rate is 25 percent (20 percent if quoted tax-inclusive).[9] Reduced rates apply to food, public transport and some other goods. From data provided by the Swedish Ministry of Finance (2016, p. 215) one can compute an average VAT rate of 21 percent (17 percent tax-inclusive). Pirttilä & Selin (2011) also use a weighted VAT rate of 21 percent.

This approach has two major weaknesses: First, some categories of consumption – notably rent and financial services – are exempt from VAT. Second, excise taxes on fuel,

[9]Tax-exclusive means that the tax rate is expressed as a proportion of the pre-tax price while tax-inclusive is in relation to the post-tax price. They are related through tax-inclusive = tax-exclusive / (1 + tax-exclusive).

Table 1: Value-added and excise tax payments in Sweden in 2014

Sector	VAT	Excises	% of final use
Households	191	62	33%*
Public sector	53	3	19%
Investment	68	5	16%
Exports			32%
Input goods	45	44	

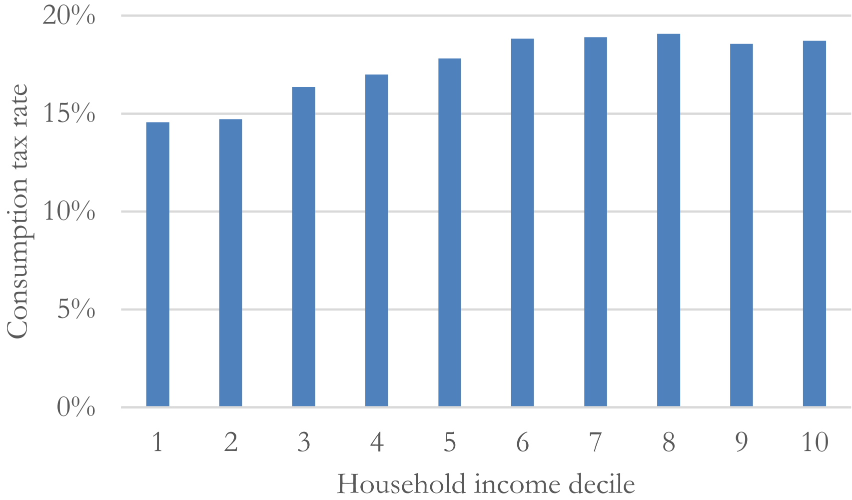
* Of which 7 percentage points is housing consumption (actual and imputed rent).
The table shows tax payments by sector in billion SEK, as well as sector shares of final use in the economy.
Source: Statistics Sweden.

electricity, alcohol and tobacco also raise the prices of consumer goods and thus reduce the return to working – either directly or indirectly by causing an increase in the cost of intermediate goods, which companies then pass on to consumers. In order to take these factors into consideration, it is common to calculate average consumption tax rates from national accounts data. In doing so, it is important to account for the fact that many taxes are paid by the public sector. Mendoza et al. (1994) suggest putting consumption tax revenue in relation to private and public consumption, excluding government wage outlays.[10] Immervoll et al. (2007) compute a tax-exclusive consumption tax rate of 20 percent for Sweden using this methodology. Lundberg (2017) finds a tax rate of 23 percent (19 percent tax-inclusive) using the same methodology. Du Rietz et al. (2015) arrive at 33 percent (25 percent tax-inclusive) by dividing VAT and excise tax revenue by total private consumption.

Sørensen (2010) has made the most ambitious calculation of the average effective consumption tax rate in Sweden. Using national accounts aggregates, he accounts for excise duties and VAT on both input goods in VAT-exempt sectors and final goods. In addition, he counts property taxes, capital gains taxes on real estate and VAT on new housing units as taxes on the consumption of housing services. In this way, he arrives at a tax-inclusive tax rate of 25 percent.

Here I provide an updated estimate of the average tax rate on consumption, excluding housing services. Table 1 shows how the SEK 471 billion of consumption tax revenue in 2014 was distributed among various uses. 252 billion was paid directly by households for their consumption. Taxes on intermediate goods in the business sector, 89 billion in total, then need to be assigned to final uses. Excise taxes on intermediate goods are, e.g., electricity taxes paid by retail establishments and fuel taxes paid by trucking companies. VAT is also payable for input goods in sectors that are exempt from VAT. This is the case for insurance, financial services and gambling, among others. It is assumed that the burden of input taxes is borne by households in proportion to their share of final use. As households' non-housing consumption expenditure makes up 26 percent of final use, including exports, 24 billion of taxes on intermediate goods are assigned to households. This implies total consumption taxes of 276 billion, which is 19 percent of non-housing consumption expenditure by households.

[10] This approach has been extended by other researchers. McDaniel (2007) takes into account the fact that some of the taxes discussed are also imposed on investment goods and estimates a tax rate of 41 percent for Sweden. Carey & Rabesona (2004) and Prescott (2004) also suggest some changes to the Mendoza et al. method.



Source: See appendix.

Figure 2: Estimated consumption tax rate by household income decile

Households save part of their income, but all income will be consumed at some point. As long as households' return on investment equals the government's discount rate (and disregarding capital income taxes), the timing of consumption will not matter for the government's budget constraint. Consumption abroad – about five percent of households' expenditures – is disregarded.

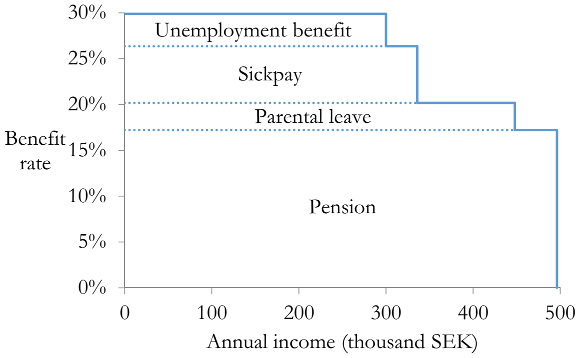
An alternative to using national accounts data is a micro approach using household surveys. This allows the researcher to analyze heterogeneity over the income distribution, but a downside is that taxes on intermediate goods will be omitted. In the appendix an average consumption tax rate of 18 percent is calculated using a household survey from Statistics Sweden. Figure 2 shows the consumption tax rate by decile of household income. Note that households with higher income are considerably larger. Having this in mind, the figure nonetheless indicates that a constant consumption tax rate may not be too crude an approximation. The average tax rate is quite stable around 19 percent for the top half of households – where most of the working population should be expected to be found.

As the national accounts and household survey calculations yield approximately the same result, a consumption tax rate of 19 percent will be used in the main analysis. This is likely to be conservative, though, as calculations by Sørensen (2010) indicate that the effective consumption tax rate is higher if one includes taxes on housing.

3.3 Social security contributions

Employers' social security contributions, also called payroll taxes, are the largest source of revenue for the Swedish central government. They are 31.42 percent of the wage. A standard assumption, which is also made here, is that the burden of payroll taxes falls completely on employees.[11] Payroll taxes are slightly lower for self-employed people. As they make up a small part of the total, these reduced rates are ignored.

[11]"for the payroll tax, virtually all applied incidence studies assume that both the employee share and the employer share are borne by the employee (through a fall in the net wage by the full amount of payroll tax). This assumption has been tested and confirmed repeatedly" (Fullerton & Metcalf, 2002, p. 1821)



Source: See appendix.

Figure 3: Estimated social insurance benefits before tax by income level

3.4 Social insurance benefits

An important step in computing effective marginal tax rates is accounting for income-dependent social benefits. The reason is that increased income will, up to a ceiling, lead to a higher pension, higher unemployment benefit, etc. Such benefits need to be subtracted from effective marginal tax rates in order to correctly characterize the return from working. Social insurance benefits are calculated in the appendix and plotted in figure 3. For incomes up to about the median, benefits before tax are calculated to correspond to around 30 percent of income.

All social insurance incomes are assumed to be subject to the average municipal (τ_m) and consumption (τ_c) tax rate. Net social insurance benefits are given by

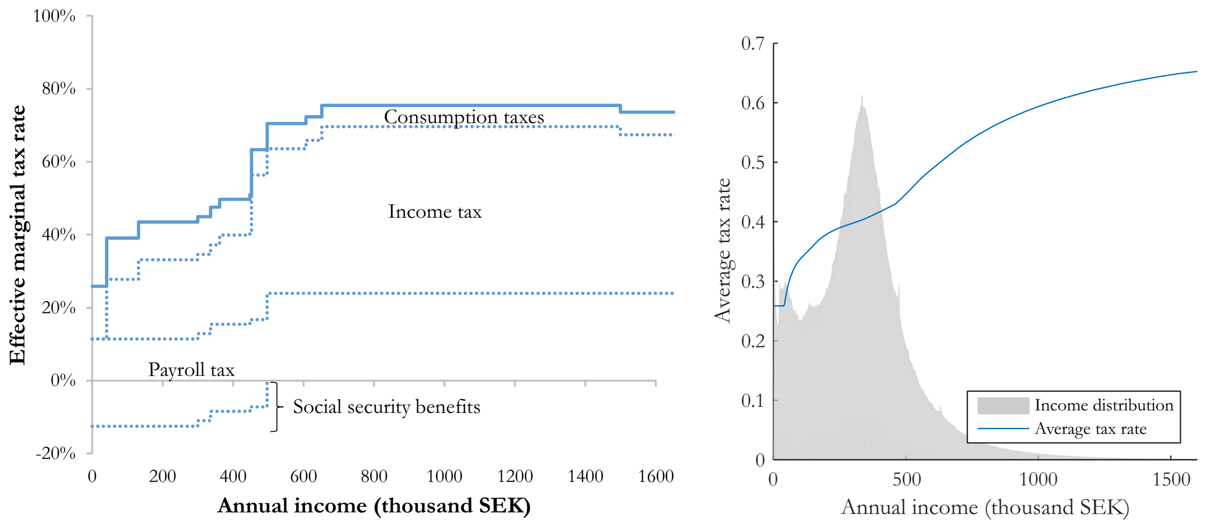
$$B(z) = (1-\tau_c)(1-\tau_m)[(0.1021+0.07)\min(z, 496300) + 0.0616\min(z, 336000) + 0.0297\min(z, 448000) + 0.0354\min(z, 300000)]. \quad (3)$$

From a legal perspective, the social insurance systems are financed by the various fees that constitute the employer's social security contributions (see table 7 in the appendix). There is also a general wage fee of 11 percent which is not connected to any benefit. For this reason, it is common to speak of a benefit and a tax part of social security contributions. What is legally labelled the benefit part does not correspond to the benefit part from an economic perspective, however. This is a source of confusion. The reason is the presence of earnings ceilings and floors. For example, the unemployment insurance fee is set to 2.64 percent because 2.64 percent of the sum of all labour incomes is equal to the government's outlays for unemployment benefit. If unemployment benefits were uncapped, this would indeed be the actuarially fair unemployment insurance premium. In the appendix, I present and apply a method for adjusting for earnings ceilings (but not floors).

3.5 Effective tax rates

Total taxes are the income tax, consumption taxes, paid as a proportion of after-tax income, and payroll taxes. The total tax liability net of social insurance benefits, as used in the simulations, is therefore given by

$$T = T_I(z) + \tau_c(z - T_I(z)) + \tau_p z - B(z), \quad (4)$$



(a) Effective marginal tax rates.

(b) Effective average tax rates and the income distribution (see section 5.2).

Figure 4: Taxation of Swedish labour income in 2017

where τ_c is the consumption tax rate and τ_p is the payroll tax rate. In principle and simplifying slightly, all taxes could be replaced by an income tax equal to equation 4 and tax revenues and individuals' behaviour would be unchanged. Social contributions are not included in taxable income (because the legal incidence is on the employer). For this reason, the effective average tax rate needs to be computed as a proportion of total labour cost, including payroll taxes. Thus, the effective average tax rate is $T/(1+\tau_p)z$. This is plotted in figure 4b. The fact that the tax system is progressive is clearly visible, although tax rates are substantial for most taxpayers. The biggest contributors to progressivity are the central government income tax and the ceiling for pensionable earnings, both of which occur at approximately the same income level. The figure also illustrates that the Swedish labour income distribution is relatively compressed, with most workers earning between SEK 200,000 and 500,000.

When differentiating the tax liability with respect to taxable income z, we obtain the increase in tax payments caused by a one krona increase in taxable income. This needs to be put in relation to the increase in total employee compensation, which is $1+\tau_p$ kronor. Thus the effective marginal tax rate is

$$T_e'(z) = \frac{T_I'(z) + \tau_c(1 - T_I'(z)) + \tau_p - B'(z)}{1+\tau_p}. \quad (5)$$

The effective marginal tax function is plotted in figure 4a. The diagram shows the contribution of each tax to the effective marginal tax rate. The contribution of the income tax, for example, is the marginal tax rate divided by one plus the payroll tax rate. The part of payroll taxes that is associated with social security benefits is viewed as a negative tax. The solid line thus shows the net effective tax rate, after subtracting social insurance benefits. The highest effective marginal tax rate is 75 percent.

4 Behavioural elasticities

The basic theory underlying the model is that the individual enjoys having a high disposable (post-tax) income, but that it is costly to supply (pre-tax) taxable income because this requires, for example, giving up leisure. Higher tax rates make it less attractive to work, and more attractive to engage in tax avoidance and evasion, and should therefore be expected to result in lower taxable income. This can take place either through a small reduction in taxable income (intensive margin) or because the individual drops out of the labour force completely (extensive margin). These behavioural responses are conventionally expressed as elasticities. In addition, there are income effects in that higher disposable income through a tax cut will induce higher demand for leisure.

In the simulations below, I will choose elasticities that are in line with the evidence for Sweden, while also considering the international literature. Intensive margin responses are measured as the elasticity of taxable income with respect to the net-of-tax rate, extensive margin responses as the elasticity of labour force participation with respect to the participation net-of-tax rate and income effects as the derivative of net labour income with respect to unearned income. In the main analysis, I target a compensated taxable income elasticity of 0.2 and an average participation elasticity of 0.15. I call this the medium scenario. These elasticites are meant to represent conservative midpoints of estimates found in the research literature. As a robustness check, results for low and high scenarios are also reported. The elasticities are shown in table 2 and motivated below. Income effects are set to correspond to slightly less than half of the compensated response.

4.1 Intensive margin

This subsection motivates the choice of compensated intensive margin elasticity and discusses the role of optimization frictions and fiscal externalities when evaluating tax reforms. Income effects are discussed in the next subsection. Starting with Feldstein (1995), a large research programme called 'the new tax responsiveness literature' has used tax reforms as identifying variation to estimate how much taxpayers adjust their taxable income when marginal tax rates change, given that they already had positive taxable income. The key parameter estimated is the elasticity of taxable income with respect to the net-of-tax rate. The taxpayer could change her behaviour in a number of ways: hours of work, deductions, productivity affecting the hourly wage, tax evasion, etc. Saez et al. (2012) survey some central papers in the international literature and state that "the best available estimates range from 0.12 to 0.4".

The Swedish part of this literature now consists of seven papers (refer to Ericson et al., 2015, for a survey). These have used tax reforms over the 1980s, 1990s and 2000s – especially the comprehensive tax reform of 1990–1991 – to estimate the taxable income elasticity in Sweden. The elasticities that are found range from 0.1 to 0.5 for men –

Table 2: Target elasticities for the three elasticity scenarios

	Low	*Medium*	*High*
Compensated intensive margin elasticity	0.1	0.2	0.3
Average extensive margin elasticity	0.05	0.15	0.25

the range is larger for women – and average about 0.3. On the basis of this literature Sørensen (2010) and Pirttilä & Selin (2011) conclude that a taxable income elasticity of 0.2 is probably a conservative estimate of the Swedish elasticity of taxable income.

In recent years, there has been increasing recognition of the need to consider optimization frictions, such as adjustment costs or inattention, that affect behavioural responses to taxation. Chetty (2012) develops the theory by showing how the researcher can use microeconometric estimates to construct bounds on the structural (frictionless) elasticity by making an assumption about the percent utility loss the agent is willing to accept by not adjusting her behaviour to match the frictionless optimum. Assuming that tolerated utility losses are 0.5 percent of net income, Chetty shows that an elasticity of 0.33 is consistent with 15 different estimates of the intensive margin elasticity in various countries.

The theory of optimization frictions can help explain why estimated elasticities are often smaller when the identifying tax variation is smaller – as observed for the Danish case by Kleven & Schultz (2014). In the short run, many taxpayers may not find it worthwhile to respond to small tax changes. In the long run, however, it is the frictionless elasticity that is relevant. For example, if the tax rate was increased from 32 to 33 percent many decades ago, it is unreasonable for taxpayers to act as if the tax rate is still 32 percent just because it is the tax rate that their grandparents were subject to.

Optimization frictions also help reconcile the elasticities in the quasiexperimental literature with the finding that bunching at kink points of the tax schedule is very small or nonexistent – at least for wage-earners – as documented for the United States by Saez (2010) and for Sweden by Bastani & Selin (2014). In a frictionless model, there should be a large excess mass of taxpayers where the marginal tax rate jumps. Bastani and Selin show that if taxpayers tolerate utility losses of one percent of net income, their finding of virtually no bunching is consistent with taxable income elasticities up to 0.39.[12]

The taxable income elasticity captures how the income tax base responds to tax changes. However, the simulation model described below also incorporates impacts on the payroll and consumption tax bases. Depending on the type of behavioural response, it is not certain that changes to taxable income will carry over into the other tax bases. For example, if higher taxes induce the worker to accept some compensation under the table, such income will still be subject to consumption taxes when spent. Another plausible response is for self-employed people to shift income from the labour tax base to capital income. For these reasons, the anatomy of the taxable income response may be important. The older labour supply literature on hours responses to taxation may be informative in this regard. If the taxpayer reduces hours worked after a tax hike, this is evidence of real responses rather than just reporting responses. Aronsson & Walker (2006) survey the literature on labour supply responses in Sweden. For men, five of the six studies that they cite find elasticities in the interval 0.05 to 0.12. The three papers that report responses of women find elasticities between 0.1 and 0.8. A reasonable or conservative estimate of the aggregate hours elasticity may thus be 0.1.

In addition, it it possible that there are some real hourly wage responses detectable in the

[12]It is illustrative to make a comparison with Ito (2014), who analyzes piecewise linear pricing in the California electricity market. He finds convincing evidence of a strictly positive price elasticity, but no bunching whatsoever. This is indicative of optimization frictions attenuating behavioural responses in a way that leads to the absence of bunching. In the case of electricity pricing, Ito shows evidence to suggest that the relevant friction is that consumers respond to average rather than marginal prices, probably because electricity bills are difficult to understand.

short run, due to taxpayers, e.g., turning down offers of promotion. Ericson et al. (2015) find hourly wage elasticities of 0.1 for men, 0.06 for single women without children and 0 for all other women, using tax variation over the period 1992–2011. Blomquist & Selin (2010) use tax reforms during the 1980s to estimate an hourly wage elasticity of 0.15 for men and much higher for women. Although some of these responses may reflect reporting behaviour, depending on the exact income data source used (employer-provided in the first case, from surveys in the second), these studies are indicative of effort responses to taxation that are reflected in pre-tax wage rates.

Because reporting responses may not be fully reflected in all tax bases, it is sensible to use somewhat lower elasticities for reform evaluation purposes. For example, if the aggregate taxable income elasticity is 0.3 (the approximate midpoint of the Swedish literature), it may be reasonable to assume that 0.1 of this reflects hours responses, 0.05 comes from hourly wage responses and 0.15 is due to tax avoidance and tax evasion. Intuitively, if the pure reporting responses are associated with a tax revenue loss of one-third – likely a conservative assumption – the fiscally relevant elasticity is 0.1 + 0.05 + 0.15 / 3 = 0.2.[13]

The elasticities cited above are aggregate elasticities for the whole population. The papers using Swedish data do not report elasticities for different parts of the income distribution. It is possible that the elasticity varies systematically by income. In particular, higher elasticities are often estimated for high-income earners in the United States (e.g., Gruber & Saez, 2002). However, there is no consensus on this so I consider the null hypothesis of a constant elasticity not to have been rejected. As results are reported for three different elasticity scenarios, it is possible for the reader to consider a higher or lower elasticity depending on which income group is affected by the tax reform in question.

Considering all of the above, 0.2 seems to be a plausible yet somewhat conservative estimate of the elasticity relevant for evaluating Swedish tax reforms. It is conceivable that the elasticity depends on the tax rate. The assumption of constant elasticity is stronger for tax reforms that are large deviations from current law.

4.2 Income effects

Higher net income should be expected to increase the demand for leisure. This works in the opposite direction from the compensated response (substitution effect) discussed in the previous section. In applied tax studies, income effects are usually measured by the income effect parameter, which is the difference between the compensated and uncompensated elasticities and also equal to the marginal propensity to earn (after-tax) labour income out of unearned income ($\eta = (1-\tau)\partial z/\partial m$, where τ is the marginal tax rate and m is exogenous income). This is not always reported in the empirical literature, which often estimates income elasticities (see Blundell & MaCurdy, 1999, for a survey of the older literature). Converting income elasticities to income effect parameters is not trivial.

Elinder et al. (2012) use wealth shocks induced by inheritances to estimate income effects in Sweden. Their sample is quite small and consists of relatively old individuals. Performing a simple back-of-the-envelope calculation, they estimate a very large marginal propensity to earn of –0.72. This includes income effects on both extensive – notably

[13] This can be derived from Saez et al. (2012, p. 11) by setting $t = 2\tau/3$ and $s = 0.15/0.3$, i.e., one thinks of the tax reporting response as being a part of the taxable income response that is being shifted to another tax base where the tax rate is two-thirds of the original tax rate.

including the retirement decision – and intensive margins. The authors note that their estimate is considerably larger than the estimated effects of wealth shocks in the United States. Smaller income effects are found by Blomquist & Selin (2010), who estimate $\eta = -0.05$ using Swedish tax reforms during the 1980s.

The most convincing evidence on income effects is provided by Cesarini et al. (2015), who use Swedish lotteries to estimate a marginal propensity to earn out of unearned income of -0.11 in a calibrated model. However, a third to half of this reflects extensive margin responses, which are not relevant when analyzing taxes on labour. Imbens et al. (2001) also find a marginal propensity to earn of -0.11 by examining the behaviour of Massachusetts lottery winners. Taking these papers as a benchmark and considering that the taxable income elasticity is 0.2 in the medium scenario, income effects are calibrated so that they correspond to slightly less than half of the compensated response.

4.3 Extensive margin

In addition to intensive margin responses, individuals are observed to jump between no taxable income and a sizeable income level. This is explained by fixed costs associated with working (see section 5.1). For such participation (also called extensive margin) responses, it is the participation tax rate that matters, rather than the marginal tax rate. Extensive margin responses are measured by the elasticity of labour force participation with respect to the participation net-of-tax rate.

I am aware of only two papers using a quasiexperimental design to estimate participation elasticities in Sweden. Selin (2014) uses the 1971 abolition of joint taxation of married couples in Sweden to estimate a participation elasticity of 1.00 for married women. Responses are much larger for women with children than without. Recent evidence on extensive margin responses in Sweden is provided by Bastani et al. (2016), who utilize a 1997 reform of the Swedish housing allowance and find a participation elasticity of 0.13 for married women. When splitting the sample into quartiles by predicted income, the elasticities are 0.24, 0.12, 0.11 and 0.09, respectively.

Internationally, a large literature has examined the effects of expansions of the American earned income tax credit under presidents Reagan and Clinton. Hotz & Scholz (2003) survey this literature and find elasticities in the range 0.69 to 1.16 for single mothers. Chetty et al. (2013) provide a broader survey of microeconometric estimates of participation responses and report Hicksian elasticities (some of which the authors calculate from studies which did not calculate or miscalculated elasticities) between 0.13 and 0.43 with a simple average of 0.25.

To sum up, there is substantial heterogeneity in these estimates. Elasticities appear to be higher for groups with weaker labour market attachment, such as women, especially those that are married or have children, and low-income workers. Given that many papers focus on such groups, it is likely that the average elasticity for the entire population is lower than found in those papers.

SLIMM only features heterogeneity in skill apart from fixed costs of work. Thus I need to decide an aggregate extensive margin elasticity and how it will vary by skill. Based on the evidence cited above, a participation elasticity of 0.15 seems to be a reasonable conservative estimate for the full population. I assume that the elasticity declines with income, taking the pattern described by Bastani et al. (2016) as a benchmark.

5 The simulation model

This section provides a technical description of the Swedish Labour Income Microsimulation Model (SLIMM). SLIMM models how much taxable labour income individuals choose to supply, given the tax system. The demand for labour is not modelled. This and other limitations are discussed in section 5.7.

The model has solid microfoundations and the income data comes from high-quality full-population registers. Individuals are heterogeneous in two dimensions, corresponding to productivity and costs of working, and maximize a utility function parameterized to generate elasticities in line with the literature. The distributions of skills and fixed costs of work are calibrated such that when individuals maximize utility given the current Swedish tax schedule, the result is exactly the observed Swedish income distribution. The model is meant to be as parsimonious as possible and the number of parameters is kept at the minimum required to model intensive margin responses, income effects and extensive margin responses in a realistic manner.

5.1 Individual optimization

Individuals are assumed to be heterogeneous in skill s and fixed cost of work q. The skill level is a measure of the individual's earnings potential. The number itself is meaningless; what matters is that income in employment increases monotonically with skill. As the skill distribution is inferred from the observed income distribution, it also reflects part-time work and the like. Fixed cost of work is any expense or disutility, e.g., commuting or childcare costs, incurred as a result of having a strictly positive labour income. The concept was introduced by Cogan (1981) and is used to explain why people often choose between a significant number of hours of work or staying out of the labour force completely.

In section 3, all tax rates were expressed as a function of the individual's taxable income z, because that is how the tax laws are written. In an economic sense, however, the relevant income concept is the employer's total labour cost, including payroll tax τ_p. For this reason, the model is expressed in terms of total labour income $y = z(1 + \tau_p)$. The tax function $T(y)$ is defined by equation 4. It is simply the sum of income, payroll and consumption taxes paid by the individual, net of income-dependent benefits received. Disposable income is therefore $y - T(y)$. Individuals who earn exactly zero receive a transfer $-T(0; s)$, which is allowed to vary by skill. I abstract from capital income and universal transfers.[14]

Taxpayers choose their income level by maximizing the following utility function:

$$\begin{aligned} u(y; s, q) &= v(y - T(y)) - \mu(y; s) - q1[y > 0] = \\ &= \frac{(y - T(y))^{1-\gamma}}{1-\gamma} - \frac{s}{1+\frac{1}{e}} \left(\frac{y}{s}\right)^{1+\frac{1}{e}} - q1[y > 0], \end{aligned} \quad (6)$$

[14] These raise the disposable incomes of everyone and thus do not matter for the fiscal consequences of behavioural responses. Nonlabour incomes do however affect the marginal utility of consumption and thus, in theory, the size of income effects. SLIMM is not a structural model in the traditional sense, though, and behavioural responses are calibrated by parameterizing the utility function to achieve reasonable observed elasticities and income effect parameter. Therefore, the absolute amount of nonlabour income is unimportant.

where e is the Frisch elasticity of labour supply and γ is approximately the ratio of income effects to the compensated response. In this context, the Frisch elasticity is the elasticity of labour supply holding the marginal utility of consumption constant. It is approximately equal to the compensated elasticity of taxable income. The utility specification, which is common in the literature, is adapted from Keane (2011). The parameter values chosen are given in table 3 and motivated below.

The first term, v, is the utility from consumption and is a function of disposable income (after deducting consumption taxes). The second term, μ, is the disutility from supplying labour income, which is lower, for a given income level, for people with higher skill s. Lastly, the third term, q, is the fixed cost incurred by everyone having a job. Because the marginal utility of consumption is declining, this utility specification features income effects.[15] For those who choose to participate in the labour force, optimal income supply is given by

$$y^*(s) = \arg\max_{y>0} u(y; s). \tag{7}$$

This must be computed numerically. In the derivations that follow, keep in mind that y^* is always a function of s.

Following Kleven et al. (2009), the assumption is that fixed costs of work follow a power law distribution. For a given skill level, fixed costs of work are distributed according to the following cumulative distribution function:

$$F(q; s) = \begin{cases} \left(\dfrac{q}{\bar{q}(s)}\right)^{\theta(s)} & \text{if } q < \bar{q}(s) \\ 1 & \text{if } q \geq \bar{q}(s), \end{cases} \tag{8}$$

where $\bar{q}$ is a parameter that determines the employment rate and θ is related to the participation elasticity. Both are allowed to vary by skill. The probability density function has the form $f(q; s) = \theta(s)q^{\theta(s)-1}/\bar{q}(s)^{\theta(s)}$ for $q < \bar{q}(s)$. The fixed-costs-of-work distribution for a worker of median income is illustrated in figure 5a.

All individuals for whom

$$u(y^*; s, q) > u(0; s, q) \Leftrightarrow v(y^* - T(y^*)) - \mu(y; s) - v(-T(0; s)) > q \tag{9}$$

will choose to be employed. Thus, the employment rate for each s, $E(s)$, can be calculated from equation 8:

$$E(s) = F\left(v(y^* - T(y^*)) - \mu(y; s) - v(-T(0; s)); s\right). \tag{10}$$

The individual's disposable income in work is $y^* - T(y^*)$ and out of work $-T(0; s)$. Thus the monetary return from working is $y^* - T(y^*) + T(0; s)$. The extensive margin elasticity ε_w is defined to be the percentage change in employment, E, in relation to the percentage change in the reward from working. This is equivalent to the elasticity with respect to

[15] If $\gamma = 0$, the utility function is quasilinear in consumption, there are no income effects and e is the the elasticity of taxable income. In this case the taxable income supply function has the form $y^*(s) = s(1 - T'(y^*))^e$ and s has the interpretation of potential income, i.e., the individual's chosen income level in the absence of taxation. In the medium scenario in the current parameterization, s is approximately five times as large as potential income. With $\gamma \neq 0$, no analytical form for the income supply function exists.

Table 3: Parameter values

	Elasticity scenario		
	Low	*Medium*	*High*
Set parameters			
Frisch elasticity (e)	.11	.23	.37
Income effect share (γ)	.5	.5	.5
Participation elasticity intercept (α_θ)	.17	.43	.58
Participation elasticity slope (β_θ)	$5/6 \times 10^{-7}$	$5/6 \times 10^{-7}$	$1/3 \times 10^{-7}$
Employment rate intercept (α_q)	1700	350	290
Employment rate slope (β_q)	1/10000	1/6000	1/23000
Out-of-work benefit skill threshold (s_b)	7×10^5	1.5×10^6	4×10^6
Targeted parameters			
Compensated taxable income elasticity (ε_c)	.102	.204	.300
Income effect parameter (η)	–.043	–.083	–.115
Participation elasticity (ε_w)	.051	.151	.247
Employment rate ($\sum n / \sum n_0$)	.859	.861	.862

Note: The first six set parameters are chosen so that the four targeted parameters come close to the values motivated in section 4 (see, e.g., table 2) and so that the employment rate is approximately 86 percent. The Frisch elasticity and the income effect share govern behaviour on the intensive margin; see section 5.3. The participation elasticity and employment rate intercepts and slopes determine behaviour on the extensive margin; see the discussion in section 5.4. The out-of-work benefit threshold is the skill level after which out-of-work benefits are constant. This is discussed in section 5.5.

the participation net-of-tax rate.[16] The return from work is altered by increasing taxes in work marginally while keeping the out-of-work benefit $-T(0;s)$ and optimal labour income y^* fixed.[17] Hence, the participation elasticity can be expressed as

$$\varepsilon_w(s) = -\frac{dE(s)}{dT(y^*)}\Big|_{y^*} \frac{y^* - T(y^*) + T(0;s)}{E(s)} =$$
$$= \frac{f\left(v(y^* - T(y^*)) - \mu(y;s) - v(-T(0;s));s\right) v'(y^* - T(y^*))\left[y^* - T(y^*) + T(0;s)\right]}{F\left(v(y^* - T(y^*)) - \mu(y;s) - v(-T(0;s));s\right)} =$$
$$= \theta(s)\frac{v'(y^* - T(y^*))\left[y^* - T(y^*) + T(0;s)\right]}{v(y^* - T(y^*)) - \mu(y;s) - v(-T(0;s))}. \quad (11)$$

[16]The participation tax rate is defined by $\tau_w = (T(y^*) - T(0))/y^*$. Thus the participation net-of-tax rate is $1-\tau_w = (y^* - T(y^*) + T(0))/y^*$, i.e., the monetary return from working divided by optimal income in work. Keeping y^* fixed, the monetary return from work will increase by the same proportional amount as the participation net-of-tax rate.

[17]As SLIMM features income effects, individuals react differently depending on whether the return to work is altered by changing out-of-work benefits or taxes on workers. Marginal utility is declining, so if the out-of-work benefit is increased, the utility difference between work and nonwork will decrease more than if disposable income in work is reduced ($v'(y^* - T(y^*)) < v'(-T(0;s))$). Thus participation responses will be stronger when changing $-T(0;s)$ than when changing $T(y^*)$. Because the model is concerned with the effects of the tax system, I calibrate the elasticity by changing taxes for those that are employed. In theory, this will induce income effects, meaning that I have to assume that y^* is constant. Numerical simulations show that allowing y^* to change has a very small impact on observed elasticities.

5.2 Income data

The income data used is the 2013 distribution of labour income[18] from Statistics Sweden's Income and Taxation Register, which covers the full population. Using full population data allows a detailed analysis of high incomes, where the income distribution is thin. Only people aged 20 to 64 are considered. The income distribution is characterized by counting the number of taxpayers in each SEK 1,000 bin. There are 2,000 bins and the last bin contains everyone whose income exceeds SEK 2 million. Each bin is assigned average income in the bin.

The distribution is scaled up to 2017 by employment and nominal hourly wage growth as forecasted by the National Institute of Economic Research (2016). As the model is intended to be policy relevant, it is important that it is expressed in current wages and quantities. This allows analysis of the current tax system, rather than the one prevailing in 2013. The crucial assumption is that the structure of the income distribution did not change in any significant way between 2013 and 2017.[19]

Employment is defined as having annual labour earnings exceeding SEK 20,000. After scaling up, the sample consists of 4.9 million employed individuals. This corresponds to an employment rate of 80 percent, which is close to the labour force survey number of 81 percent. The population in official registers is somewhat larger than in population statistics, due to the fact that some people feature in the register even though they lived in Sweden – or were alive – for only part of the year. Total labour income is SEK 2.2 trillion. Aggregate tax revenues as defined in the model are 1 trillion, for an average tax rate of 45 percent. Benefits to those out of work as specified by equation 12 are 36 billion in total.

When predicting the skill of the nonemployed in section 5.4 below, I use 2013 data from the LINDA database, which contains register data from a random sample of 3.35 percent of Sweden's population. After restricting the sample to ages 20–64, 200,000 individuals remain. This database is used because it contains a larger set of demographic variables.

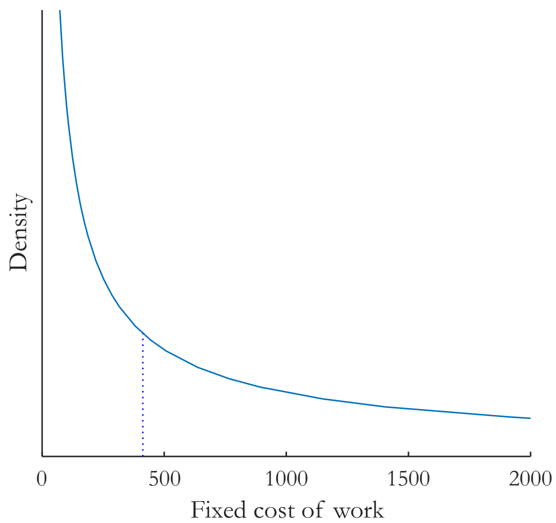
5.3 Calibration of the intensive margin

In equation 6, the parameters e and γ determine responses on the intensive margin. e is the Frisch elasticity of labour supply. It is slightly larger than the compensated (Hicksian) elasticity ε_c, which is what I target.[20] γ is approximately the ratio of income effects to compensated responses: $\eta \approx -\gamma\varepsilon_c$. Recall from section 4.2 that the income effect parameter η is the derivative of net income with respect to non-labour income. The parameter values are shown in table 3. In line with the evidence cited in section 4, I set $\gamma = 0.5$ for all three scenarios, meaning that the income effect parameter will be slightly less than half the compensated elasticity in absolute value.

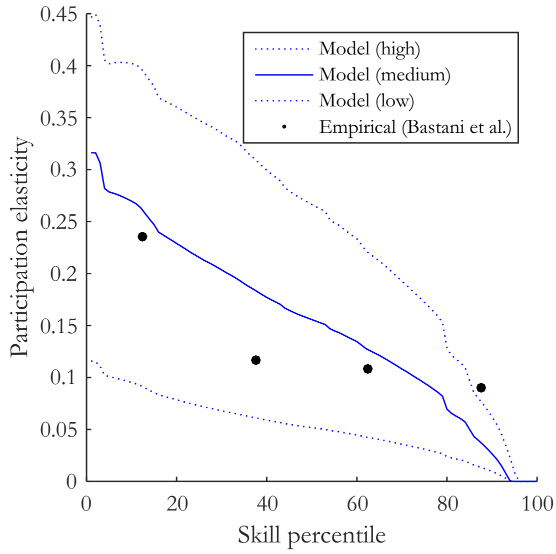
[18] More precisely, the income concept is EITC-eligible income, *underlag för jobbskatteavdrag.*

[19] This is standard practice for microsimulation models. For example, the congressional Joint Committee on Taxation uses microdata that is generally three years old.

[20] Following Keane (2011, p. 967–968), it can be shown that, under the assumption of a linear tax schedule and no non-labour income, $\eta = -\frac{\gamma}{1/e+\gamma}$, $\varepsilon_u = \frac{1-\gamma}{1/e+\gamma}$ and $\varepsilon_c = \frac{1}{1/e+\gamma}$. In the medium scenario, this implies $\eta = -0.103$, $\varepsilon_u = 0.103$ and $\varepsilon_c = 0.206$. As the tax schedule considered here is non-linear, these expressions will only hold approximately.



(a) Probability density function for the distribution of fixed costs of work for the median taxpayer. The utility difference between work and non-work (excluding the fixed cost) given the current tax system is dotted. The area to the left of this line is the current employment rate.



(b) Extensive margin elasticity by skill percentile, along with estimates from Bastani et al. (2016).

Figure 5: Modelling extensive margin responses

The actual elasticities in the model need to be calculated numerically and are shown in table 3. The average income effect parameter is calculated by increasing everyone's non-labour income from zero to one percent of their skill level s and observing the change in optimal labour income. There is more empirical evidence available on taxable income elasticities than on income effects. Therefore, I set the Frisch elasticity to almost exactly match the compensated elasticities in table 2, i.e., 0.1, 0.2 and 0.3 for the low, medium and high scenarios, respectively. The uncompensated elasticity is calculated by increasing every taxpayer's net-of-tax rate by one percent and calculating the average increase in taxable income. Adding the (negative) income effect parameter, the compensated elasticities in table 3 are obtained.

Using the utility function – specified in equation 6 and parameterized as described above – the distribution of skills (the individual-specific parameter s) can be inferred. For each income level (SEK 1,000 bin), equation 7 is numerically inverted to find the skill level that would rationalize observed income, given today's tax schedule.[21]

5.4 Calibration of the extensive margin

For the extensive margin, I calibrate four parameters (α_θ, β_θ, α_q and β_q) to attain four objectives: an aggregate employment rate of 86 percent, a participation elasticity of 0.05, 0.15 or 0.25, depending on scenario, employment rates increasing with income and participation elasticities declining with income. Parameter values for the three elasticity scenarios are shown in table 3. These parameters determine $\theta(s)$ and $\bar{q}(s)$ in equation 8,

[21] The Matlab functions used are `fminbnd` and `fzero`.

which in turn decide how fixed costs of work are distributed for each skill level and thus employment rates.

The parameter θ, which, as we see in equation 11, influences the magnitude of extensive margin elasticities[22], is calibrated to achieve an elasticity in line with table 2 and a declining pattern with respect to skill:

$$\theta(s) = \alpha_\theta - \beta_\theta s.$$

Figure 5b shows how extensive margin elasticities vary by skill percentile. Estimates from Bastani et al. (2016) are shown for comparison. As they estimate on a sample of low-skill individuals, in the medium scenario, I undershoot their estimates for high skill levels. At the same time, their estimated elasticity is lower than many other papers, which is why I choose a larger elasticity for low skill levels.

I also need to calibrate the parameter $\bar{q}$, which determines employment rates. Naturally, labour incomes are only observed for those who are employed. In order to predict employment rates, I regress labour income on dummies of gender, marital status, number of children, continent of birth, county of residence, detailed educational attainment category (high-school dropout, university degree etc.) and field of study as well as a flexible specification for age. I order these predicted incomes in 20 groups (ventiles) and find the employment rate – defined as the proportion of individuals having labour income of at least SEK 20,000 per year – for each ventile. I then calibrate $\bar{q}$ so that employment rates by skill level in the model are slightly higher than empirical employment rates:

$$\bar{q}(s) = \alpha_q + \beta_q s.$$

The model fit is shown in figure 6a.

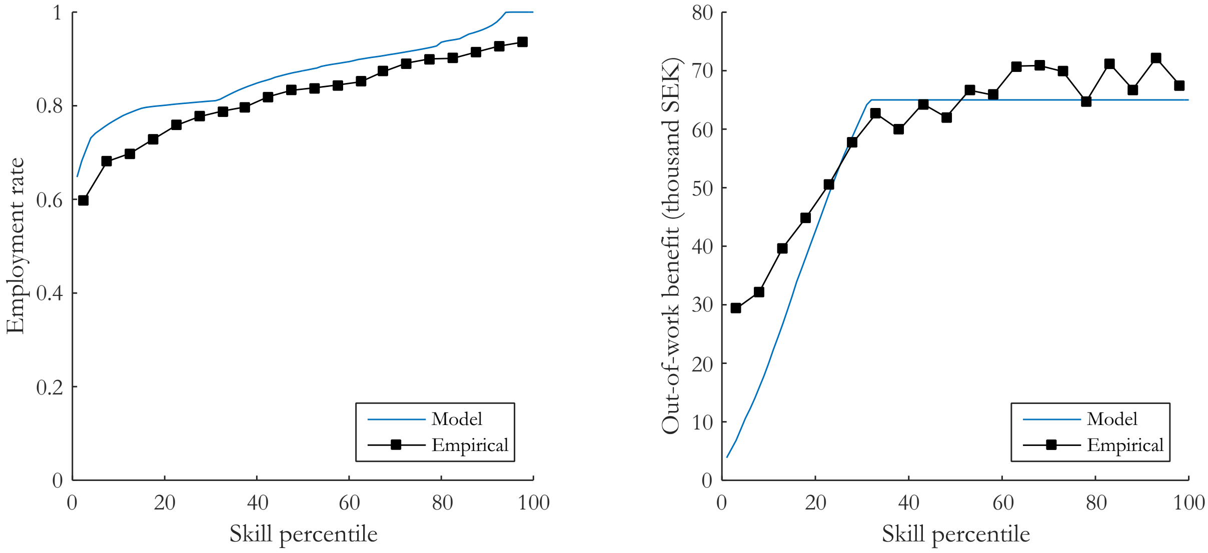
After the distribution of fixed costs of work has been parameterized, potential employment for each income level (bin) is calculated from the estimated employment rates given the current tax system: $n_0(s) = n(s)/E(s)$, where n is the observed number of people in the bin and n_0 is potential employment. Because I target an aggregate employment rate of 86 percent while the actual number is closer to 80 percent, potential employment is 95 percent of the working-age population. This leaves room for about 5 percent to never be able to work – in other words, having an infinite fixed cost of work. The functional form for fixed costs of work implies that the elasticity is approximately constant. This means that the employment rate primarily matters when evaluating large tax cuts, which induce employment rates of 100 percent for some income groups.

5.5 Cash benefits

For the population at large, the benefit system is important for the participation decision but matters less for effective marginal tax rates. Transfers to the working population affect only a minority of taxpayers and the aggregate amounts are small in relation to total tax revenues.[23] Therefore, cash benefits are accounted for when modelling the extensive

[22] If there are no income effects ($v(x) = x$) and no disutility of work ($\mu = 0$), θ is exactly the participation elasticity. This is the case in the model set up by Kleven et al. (2009).

[23] The main benefit systems and fees affecting labour income earners are housing benefit, child care fees and social assistance (*försörjningsstöd*). Housing benefit is offered to families with children and young



(a) Employment rates by skill percentile in the model (medium scenario) and empirical employment rates by ventile of predicted income.

(b) Out-of-work income in the model compared to the difference in transfer income received between the employed and nonemployed for each skill percentile.

Figure 6: Characteristics of the extensive margin

margin but not the intensive margin. How this will bias the results is ambiguous. For example, the exclusion of the housing benefit – which is phased out at a rate of 20 percent – implies that effective marginal tax rates, and therefore intensive margin responses for a given elasticity, are too low for 3 percent of the working population. For the 1 percent that receives social assistance, no behavioural responses should be expected on the intensive margin because the effective marginal tax rate will be 100 percent regardless of how the tax system looks. The proportion affected by the benefit system is higher in certain low-income subgroups, such as single mothers receiving housing benefit. This should be kept in mind when interpreting the output of the model.

Because transfers to workers are not modelled, the out-of-work benefit $-T(0; s)$ should be interpreted as the increase in transfer income when a person leaves employment. This is the fiscally relevant quantity. Because I only observe individuals in one of the states work and non-work, I use my demographically predicted income variable described above to connect the two. For each ventile of predicted income, I find average transfer income.[24] Among the employed, the lowest third of the skill distribution receive about SEK 20,000. This declines slowly to 10,000 for the highest skill group.[25] In contrast, transfer income

people with low incomes. The phase-out raises effective marginal tax rates by 20 percentage points. Housing benefits are about SEK 5 billion in total. Child care fees are at most six percent of income up to a ceiling and total about 7 billion. Aggregate payments of social assistance – a last-resort benefit system available to those with no other means of providing for themselves – are about 14 billion. For the reasons discussed below, take-up is far from perfect. The same is true for housing benefit. Of all the individuals counted as employed in the model, about three percent take up housing benefit and one percent receive social assistance. Even among the poorest tenth of workers – those earning between SEK 20,000 and 100,000 annually – only ten percent receive housing benefit and six percent receive social assistance.

[24]Transfer income is calculated as the sum of taxable and nontaxable positive transfers (excluding student loans and child benefit) minus income tax on transfers (i.e., excluding labour and capital income tax). It is scaled up by income growth and consumption taxes are subtracted.

[25]The implicit marginal tax rate (ignored in the model) is at most about 5 percent, although it is

increases with skill for the nonemployed, from SEK 50,000 to about 80,000. For each skill ventile, I calculate the difference between transfer income received by the employed and those out of work. The result is shown in figure 6b. It appears as though the benefit difference increases in the lower third of the skill distribution and then stays approximately constant. Based on this evidence, I choose the following specification for out-of-work income (net of consumption tax):

$$-T(0;s) = \begin{cases} 65000 \times s/s_b & \text{if } s < s_b \\ 65000 & \text{if } s \geq s_b. \end{cases} \tag{12}$$

The out-of-work benefit will thus increase up to a skill level of s_b, after which it will be flat at SEK 65,000. The skill threshold is chosen to represent about the 33rd percentile of the skill distribution. The numerical values for the three elasticity scenarios are provided in table 3. The chosen skill threshold corresponds to a realized income of SEK 250,000 in the current tax system. This is only slightly lower than the earnings ceilings for unemployment insurance and sickpay (see table 7). However, the benefit amount is quite low – social assistance, the legally guaranteed standard of living, for a single person is about SEK 100,000 (80,000 after deducting consumption taxes). The reason is that many people have no or very low registered incomes and still do not apply for social assistance. One explanation is that eligibility for social assistance is determined on the household level, so that an individual with very low income is expected to live off the income of their partner if the partner can provide for them both. In addition, there is an asset test for social assistance; takers must have extinguished their savings. Stigma could also contribute to lower-than-expected social assistance take-up.

I undershoot the transfer income difference somewhat for low skill levels. This is because I assume that out-of-work income approaches zero as the skill level approaches zero. This is required in order to ensure that utility from working (excluding the fixed cost) is always higher than utility from not working. The reason is that we observe workers at all income levels and the functional form for the distribution of fixed costs of work does not allow negative fixed costs. In order for the model to generate positive employment rates at all earnings levels, out-of-work benefits need to be sufficiently low. One way of thinking about this issue is that those low-skill people who would enter the labour market after a tax reform are probably receiving low benefits. If they received the standard social assistance level, taking a low-paying job would still reduce utility even if the tax on labour force participation was decreased.

Because of the uncertainty surrounding out-of-work benefits, a robustness check is provided in the appendix.

5.6 Using SLIMM for reform evaluation

The components of the model are constructed in a sequence of steps that can be summarized as follows. First, the income distribution is characterized by counting the number of taxpayers per SEK 1,000 bin. Second, the utility function (equation 6) is parameterized to generate plausible intensive margin responses. Third, the taxable income supply function (equation 7) is inverted in order to find the skill distribution that would generate the

unclear to what extent this can be given a causal interpretation.

observed income distribution, given today's tax schedule. Fourth, the parameters in the distribution of fixed costs of work ($\theta(s)$ and $\bar{q}(s)$ in equation 8) are calibrated to achieve reasonable employment rates and extensive margin elasticities. Fifth, potential employment for each bin is calculated from the employment rates obtained in the previous step and observed employment in each bin.

Thus the distribution of skills and behavioural parameters (table 3) have been calibrated. Together with the description of the existing tax (equation 5) and benefit (equation 12) systems, this allows policy evaluation by hypothetically changing aspects of the tax system and letting individuals maximize utility given the new tax schedule.

Total tax revenues are given by

$$R_{jk} = \sum_i n_{0i} \left[E_k(s_i) T_j(y_k^*(s_i)) + (1 - E_k(s_i)) T(0; s_i) \right], \tag{13}$$

where i indexes the bin. The subscripts j and k indicate whether tax rates, taxable incomes and employment rates are at their initial levels or after a reform has been implemented.

By comparing tax revenues before and after a tax reform, and with and without allowing for behavioural responses, the degree of self-financing for a tax reform can be calculated. It is given by

$$DSF = -\frac{R_{22} - R_{21}}{R_{21} - R_{11}}. \tag{14}$$

The subscripts 1 and 2 indicate before and after the reform respectively. The denominator is the mechanical revenue impact, i.e., tax revenues evaluated at the new tax schedule but keeping incomes and employment rates constant, minus initial tax revenues. The numerator is the behavioural effect on revenues, i.e., actual tax revenues after the reform minus what tax revenues would have been if there were no behavioural responses (the new tax function evaluated at the old incomes and employment rates). Normally, the degree of self-financing will be positive, implying that the behavioural and mechanical effects will have opposite signs.

The change in employment brought about by a tax reform is given by

$$\sum_i n_{0i} E_2(s_i) - \sum_i n_{0i} E_1(s_i). \tag{15}$$

5.7 Limitations

SLIMM only features heterogeneity in skill and fixed cost of work and thus misses other types of heterogeneity, such as family situation, age and gender. This can explain why there is such diversity of fixed costs of work even for people at the same skill level. SLIMM also does not model the benefit system in detail – see the discussion in section 5.5 – and benefits are a bit too low on average for low incomes – see figure 6b. A robustness check where the level of benefits is altered, keeping everything else constant, is performed in table 8 in the appendix. In addition, some transfers are taxable, which generally raises marginal tax rates by pushing taxpayers into higher tax brackets and by interacting with the EITC in a complex way. As transfers to the working population are small on average (see section 5.5), the assumption that workers receive no other taxable income than labour income probably affects the results little.

SLIMM does not model intra-household linkages. This would be complicated and the conclusions borne out by the model would be dependent on assumptions about such interactions. Cesarini et al. (2015) examine the impact of lottery winnings on spouses' labour supply, i.e., intra-couple income effects. They find that such effects are small in relation to the effect on one's own earnings. There could also be cross-substitution effects. Gelber (2014) notes that the sign of such effects is theoretically ambiguous. If someone's marginal tax rate increases, inducing lower labour supply, the labour supply of the spouse could either rise or fall. Using the Swedish tax reform of 1990–1991 as identifying variation, Gelber finds that the leisure times of spouses are complementary. This implies that the response of the spouse would amplify an individual's response to a tax reform and thus that SLIMM understates behavioural responses slightly. This effect is also small in relation to an individual's own response, however.

An implicit assumption is that any additional tax revenue raised will be used in a way that does not affect individual behaviour or the economy's productive capacity, such as defence or foreign aid. In general, the effects of a tax reform depend on how the additional funds are used or how the tax cut is financed. For example, spending on training may improve human capital while higher benefits for people out of work will further exacerbate the negative incentive effects of a tax hike. In most developed countries, only a minority of government spending is funnelled into productivity-enhancing activities like education, infrastructure and research. A large part is transfers to households. Hansson (2007) classifies two-thirds of Swedish government expenditures as redistribution. If funds raised by a tax cut are used to expand all categories of spending proportionately, one should therefore probably expect the negative effects on employment and the income tax base to be even larger than predicted by this model. I could finance all tax reforms by adjusting a lump-sum tax or transfer to all individuals, but this would induce income effects and muddle the interpretation of the analysis.

The model is limited to simulating such effects as have been detected in the quasiexperimental literature, which captures medium-term adjustment at the individual level. Therefore it misses long-term responses, such as effects on human capital accumulation, and possible responses at the group level, such as changes to collective bargaining agreements. Both of these are potentially important effects and their absence implies that behavioural responses are probably biased downward (although there could also be income effects on the group level). Some attempts at quantifying the impact of these effects have been made. Badel & Huggett (2014) introduce human capital into a structural model and find that human capital responses are at least as important as hours responses. Kreiner et al. (2015) estimate a structural model on Danish data and conclude that accounting for job mobility raises the taxable income elasticity by 0.15 to 0.35. Chetty et al. (2011) find evidence of wage formation responses in Denmark, implying that true macro elasticities could be larger than those detected in the microeconometric literature.

From a theoretical point of view, SLIMM considers only the supply of taxable labour income, and thus implicitly assumes that labour demand is perfectly elastic. Accounting for labour demand is potentially complicated. If labour supply increases uniformly across the income distribution, wages should fall in the short run but in the long run one would expect the capital stock to adjust and bring back wages to their starting level (otherwise countries with larger populations would have lower wages). In practice, demand effects are likely most relevant when considering tax reforms that induce labour supply responses among low-skill workers. Peichl & Siegloch (2012) introduce labour demand effects into a structural model and find that about a quarter of labour supply effects are offset by labour demand adjustment. A more subtle point is that the elasticities used are estimated from actual reforms. This implies that labour demand effects are captured by microeconometric techniques – at least if the reform used for identification affects a large share of the population. Extensive margin elasticities strictly reflect effects on employment, not labour force participation, and intensive margin elasticities show responses of actual rather than supplied labour incomes. Thus it could be argued that the model does in fact include labour demand effects, although this makes the theoretical interpretation more complicated.

6 Reform evaluation

With the use of SLIMM, aspects of the tax code can easily be altered and behavioural and fiscal effects can be estimated. This section analyzes three types of tax reforms that are frequently discussed in the Swedish debate: in-work tax credits, changes to municipal tax rates and tax cuts for high-income earners. The in-work tax credits analyzed are the existing EITC, a tax credit targeted at the working poor as in the United States and a simplified EITC in the form of a uniform personal allowance as in the United Kingdom. For high income earners, results are reported for the abolition of the central government income tax (practically introducing a flat tax) and of the top five percent of the central government income tax (*värnskatten*). These six tax reforms are summarized in table 4 and discussed in detail in the following sections. Four of the reforms considered are tax cuts. When analyzing municipal income taxation, an increase of one percentage point is simulated. The EITC is analyzed by simulating the effects of its removal.

The main quantity of interest is the degree of self-financing (DSF), which shows the extent to which a tax cut pays for itself through behavioural responses, or, in the case of a tax increase, the proportion of the mechanical revenue increase that is erased by behavioural responses (see equation 14). The DSF can be decomposed into the impact of substitution and income effects on the intensive margin and extensive margin responses; see table 5. A robustness check concerning the contribution of the extensive margin to the DSF depending on the size of benefits is performed in table 8 in the appendix. It should be noted that degrees of self-financing are approximately proportional to the elasticity for

Table 4: Summary of tax reforms for the three elasticity scenarios

Reform	**Budget effect***	**DSF** (%)**			**Employment*****		
		Low	*Medium*	*High*	*Low*	*Medium*	*High*
EITC removal	81	6%	21%	35%	−44	−128	−202
US-style EITC	−38	−14%	−16%	−27%	51	149	225
UK-style PA****	−38	6%	20%	34%	24	70	111
Higher municipal tax	14	18%	43%	70%	−4	−13	−22
Flat tax	−38	51%	102%	157%	1	2	5
Värnskatten	−4	82%	167%	260%	0	0	0

* SEK billion, mechanical calculation. ** Degree of self-financing. *** Change in thousands.
**** Personal allowance.

Note: The reforms are described in the text.

the margin in question. The elasticities used in the different scenarios are given in table 2.

The estimated impact on employment (equation 15) is also reported. Note that this includes individuals with very low labour incomes (as long as they exceed SEK 20,000 per year). This is similar to the employment definition in labour force surveys, where it is sufficient to have done some work to count as employed.

The main text focuses on the medium elasticity scenario. Behavioural impacts in the low and high scenarios are provided in the tables. The results of previous research are reported throughout. For an overview of the literature, see section 2.

6.1 The earned income tax credit

The earned income tax credit (EITC) is one of the biggest tax changes since the tax reform of 1990–1991. It was implemented in five stages in 2007, 2008, 2009, 2010 and 2014. A phase-out region was introduced in 2016. The tax credit reduces workers' annual tax liability by up to SEK 27,000. During the past decade, there has been a heated political debate on its effects on employment.

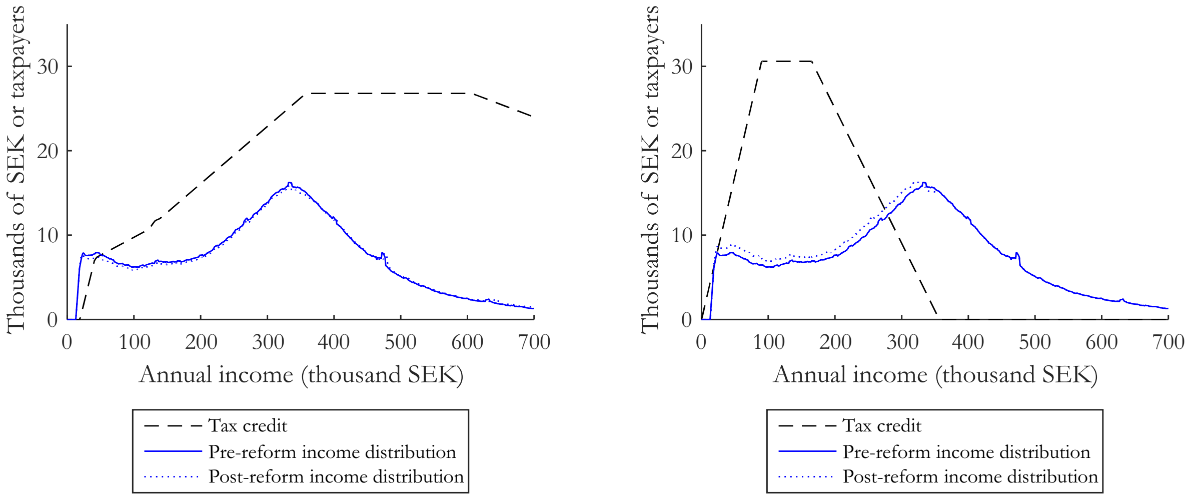
Because the EITC is already in place, the reform simulated is its repeal. The effects of such a reform are the exact same (but with opposite sign for the employment effect) as the effects of having the EITC in place. Removing the EITC would raise taxes by SEK 81 billion, mechanically speaking[26], and the estimated DSF is 21 percent. The phase-in of the EITC lowers marginal tax rates for all incomes up to about average earnings, but at the same time, the phase-out region raises the marginal tax rate by three percentage points for high incomes. On net, the substitution effect on the intensive margin still contributes positively to the DSF, increasing it by two percentage points[27] in the medium scenario; see table 5. The EITC raises disposable incomes for almost all workers, inducing income effects. This reduces the DSF by ten percentage points. As expected, the largest effect is on the extensive margin. Employment is calculated to be 128,000 higher than it would have been without the EITC, an increase of 2.6 percent. This contributes 28 percentage points to the DSF. The impact on the income distribution is illustrated in figure 7a.

The SLIMM estimate is in line with most earlier evaluations of the EITC. While it has not been possible to ex-post evaluate the EITC due to lack of a control group (Edmark et al., 2016), many simulation studies exist; the Swedish Ministry of Finance (2012) provides a survey. Most use the model SWEtaxben (see the description in section 2). Ryner (2014) estimates that the EITC increases employment by 90,000, which, together with intensive margin responses, lead to an increase of hours worked by 2.4 percent using this model. Flood (2010) calculates a DSF of 23 percent for the first four stages of the EITC, rising to 33 percent if hourly wage responses are considered. He estimates an employment effect of 72,000.

Calculations by the National Institute of Economic Research (*Konjunkturinstitutet*) for the Swedish Fiscal Policy Council (2008, p. 199) indicate that the EITC as of 2008 had

[26] This is the fiscal effect net of consumption taxes. Given that I assume a consumption tax rate of 19 percent, the mechanical gross fiscal effect (which is how taxes are reported in government budgets) is 100 billion. In the Swedish budget for 2017, the EITC is budgeted at 109 billion. The difference could be explained by the fact that the present model only considers people of working age.

[27] If the effect of the recently introduced phase-out region is ignored, this rises to about seven percentage points, bringing the total DSF to 25 percent.



(a) The current Swedish EITC and the estimated effect on the income distribution of its removal.

(b) How an American-style EITC would look in Sweden and its estimated effect on the income distribution.

Figure 7: The shape and effect of two different in-work tax credits

a DSF of 69 percent, using an intensive margin elasticity of 0.1 and an extensive margin elasticity of 0.2 on average (0.8 for those with the lowest incomes and then declining exponentially by income). The National Institute of Economic Research (2009) used a participation elasticity of 0.1 to estimate that expanding the EITC is associated with a DSF of about 20 percent. The calculations here are thus in line with most previous evaluations of the EITC.

6.2 An American-style EITC

Despite sharing the same name, the Swedish and American earned income tax credits are quite different. In Sweden, the EITC is received by over 99 percent of all labour income earners. The phase-out region only affects high-income earners. Those with incomes just above average receive the largest tax credit. The main purpose of the Swedish EITC is to increase the difference in disposable income between being employed and receiving benefits such as sickpay or unemployment benefit (both of which are taxable) for all income levels and regardless of family situation.

In contrast, the American EITC is a transfer programme aimed at low-income workers with children. It reduces the marginal tax rate to negative numbers at phase-in and raises the marginal tax rate by 16 or 21 percentage points at phase-out. The EITC is generally viewed as a successful programme in promoting labour force participation among low-skill parents and in redistributing to low-paid workers.

In order to assess whether an American-style EITC would be a desirable policy option for Sweden – for example in light of the current debate on the need to create low-skill jobs for newly arrived refugees – I simulate the fiscal and employment effects of introducing an EITC for all working Swedes corresponding to the one available in the United States to unmarried filers with one child. Converting to Swedish kronor at the exchange rate 9 SEK/USD (which is both the market and the PPP exchange rate), this corresponds to a tax credit phased in at a rate of 34 percent from 0 to SEK 90,000 per year, where the maximum EITC of SEK 30,000 is reached. Once annual income exceeds SEK 165,000, this is phased out at a rate of 16 percent. Thus the tax credit is fully phased out at SEK 357,000.[28] As is the case in the United States, it is simulated as a refundable tax credit, meaning some individuals will have negative income tax liabilities.

Introducing such a tax credit on top of the existing EITC would cut taxes for 59 percent of working Swedes and imply a tax revenue shortfall of SEK 38 billion, mechanically speaking. When allowing for behavioural responses, the reform is expected to increase employment by 149,000 (an increase of 3 percent) and decrease tax revenues by 44 billion. The impact on the income distribution is illustrated in figure 7b. The fact that the decline in tax revenue is even bigger in a behavioural calculation means that the tax change has a degree of self-financing of –16 percent.[29] This is explained by the fact that the phase-out increases marginal tax rates sharply in a region where many wage-earners are located, inducing large, unfavourable intensive margin responses which depress the DSF by 38 percentage points. In the United States, the income distribution is less compressed, meaning intensive margin responses due to the EITC phase-out are less of a concern.

Although extensive margin responses are quite large, the individuals who would enter the labour force have quite low incomes. Thus participation responses are not large enough to bring the DSF into positive territory. A negative DSF does not mean that the reform is unequivocally undesirable. If the government feels that is it important to cut taxes for low-income wage-earners while preventing tax cuts for those with high incomes, it might be ready to accept negative degrees of self-financing.[30]

As discussed in section 5.7, the model does not, at least explicitly, account for labour demand. The collective agreements currently in force on the Swedish labour market rarely allow full-time annual salaries below SEK 250,000. If the purpose of an EITC reform is to increase the number of people working full time earning around SEK 100,000–200,000, it would thus have to be coupled with reforms of the structure of the labour market. However, as can be seen in figure 7b a significant number of people are already in this region. This is explained by part-time and seasonal work. One can easily imagine that lower taxes for those with low annual incomes would encourage this type of work. This should be taken into account when evaluating the impact on employment.

Other studies have also found that EITC-type policies are associated with negative degrees of self-financing. Immervoll et al. (2007) calculate that a Swedish working poor programme consisting of a uniform tax credit to all in work financed by a small increase in all marginal tax rates would reduce revenues by 17 percent more in a behavioural calculation than in a mechanical calculation. Aaberge & Flood (2013) use the SWEtaxben model to simulate the introduction of a US-style EITC in Sweden. Just as in the present paper, they consider a tax credit of the form offered to American parents with one child. However, they model it as a nonrefundable tax credit offered only to single mothers. Thus the participation elasticities in their model are higher – 0.29 on average, even higher for low-income earners – than in SLIMM. Aaberge and Flood find a DSF of –153 percent. Hendren (2016) estimates a DSF of −14 percent for expanding the EITC in the United States.

[28] Note that the Swedish EITC is not fully *phased in* until SEK 362,000 per year.

[29] This is quite sensitive to the magnitude of benefits; see table 8 in the appendix.

[30] In the language of Bastani & Lundberg (2016), a negative DSF corresponds to a social marginal welfare weight greater than one.

Table 5: Decomposition of degrees of self-financing for six tax reforms

	DSF decomposition			
Reform	*Substitution effect*	*Income effect*	*Participation effect****	**Total DSF***
Low elasticity scenario				
EITC	1%	−5%	10%	6%
US-style EITC	−19%	−4%	10%	−14%
UK-style PA**	2%	−4%	8%	6%
Higher municipal tax	17%	−5%	7%	18%
Flat tax	54%	−4%	1%	51%
Värnskatten	87%	−5%	0%	82%
Medium elasticity scenario				
EITC	2%	−10%	28%	21%
US-style EITC	−38%	−6%	29%	−16%
UK-style PA**	4%	−9%	25%	20%
Higher municipal tax	33%	−9%	20%	43%
Flat tax	109%	−9%	2%	102%
Värnskatten	176%	−8%	0%	167%
High elasticity scenario				
EITC	4%	−15%	47%	35%
US-style EITC	−56%	−14%	46%	−27%
UK-style PA**	6%	−13%	41%	34%
Higher municipal tax	50%	−13%	34%	70%
Flat tax	163%	−12%	5%	157%
Värnskatten	266%	−6%	0%	260%

* The decomposition may not add up to the total exactly because of interaction effects and rounding.
** Personal allowance. *** A robustness analysis is provided in table 8 in the appendix.

6.3 UK-style personal allowance

A common criticism of the Swedish EITC is that it is complicated. (Swedish Fiscal Policy Council, 2008) One way to remedy this would be to replace the EITC and the basic deduction with a high personal allowance that is independent of income. This would greatly simplify the income tax by removing the effects of the EITC on the marginal tax schedule. Such a system is currently in place in the United Kingdom, although the personal allowance is phased out for high incomes. The personal allowance for the fiscal year 2016/2017 is £11,000, corresponding to about SEK 120,000. As can be seen in figure 1a, the untaxed part of income is currently at most SEK 97,000 in Sweden.

Introducing a uniform personal allowance of SEK 120,000 would cut taxes by SEK 38 billion. 20 percent of this would be recouped through behavioural responses in the medium scenario. The reform would reduce taxes for all, but especially for low-income earners. Therefore employment is calculated to increase by 70,000 through extensive margin responses. This contributes 25 percentage points to the DSF.

Turning to the intensive margin, marginal tax rates would rise for incomes between SEK

120,000 and 360,000 because the EITC would no longer be phased in. However, the elimination of the phase-out region would cut marginal tax rates by three percentage points for high-income earners. On net, compensated intensive margin responses increase the DSF by four percentage points. At the same time, income effects reduce the DSF by nine percentage points. Overall, the effects are not very different from those of the existing EITC. The Research Service of the Swedish Riksdag (2015) evaluated a very similar reform that would tax-exempt all labour incomes up to SEK 128,000. Using the FASIT model, which is practically the same as SWEtaxben, they found a DSF of 8 percent and an employment increase of about 50,000.

6.4 The municipal income tax

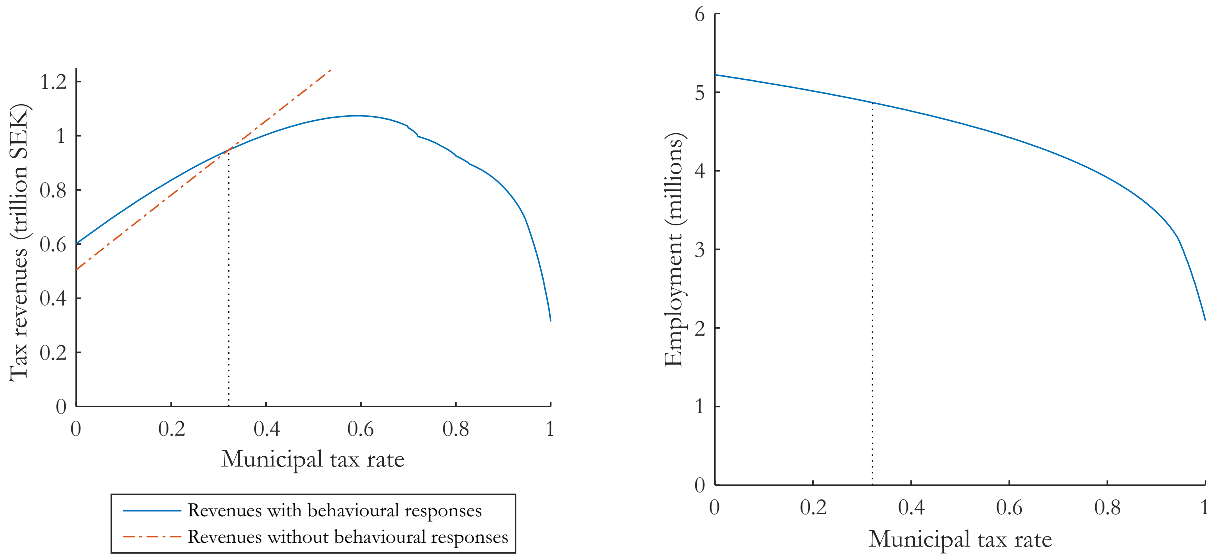
The average municipal tax rate is currently 32 percent, of which about one-third is county council tax and two-thirds is attributable to (primary) municipalities. Abstracting from the basic deduction and the EITC, it is a proportional tax on all taxable income. Municipal tax rates have gradually trended upward over the last few decades, and this is projected to continue. The Swedish Association of Local Authorities and Regions (2016) expects demographic pressures associated with immigration and an increasing proportion of older people coupled with large birth cohorts to lead to further increases in the coming years. The effects of such increases on employment and the tax base are of great policy interest. At the same time, the municipal equalization system – where 85 or 95 percent of a revenue increase caused by a larger tax base is redistributed to other municipalities – means that a municipality has virtually no incentive of internalizing such negative consequences, as most of the costs will be absorbed by the other municipalities and the central government.[31]

In SLIMM, the degree of self-financing for a one-percentage-point increase in municipal tax rates is 43 percent, i.e., behavioural responses would erase 43 percent of the increase in revenue. The majority of this – 33 percentage points – can be attributed to substitution effects on the intensive margin. Income effects and extensive margin responses are also important. Increasing municipal tax rates leads to higher marginal tax rates across the board, with very different fiscal consequences for different income groups. When increasing municipal tax rates only for those who earn less than the threshold for central government income tax, the DSF is 27 percent. However, almost all the employment effect – a decrease of 13,000 – takes place in this region of the income distribution. When raising marginal tax rates for those who pay central government income tax – about a fifth of taxpayers – the DSF is 161 percent. The reason is that marginal tax rates are already high for high-income earners. Income and participation effects are negligible in this region.

The SLIMM estimate for the DSF of municipal tax changes is higher than estimates from SWEtaxben: The Swedish National Audit Office (2012) reports that raising the municipal tax rate by one percentage point would reduce aggregate hours worked by 0.24 percent and thereby 15 percent of the mechanical revenue increase would disappear due to behavioural responses – 24 percent if hourly wage responses are also considered.

My estimates are more in line with models using exogenous elasticities. Immervoll et al. (2007) estimate that a uniform increase in marginal tax rates is associated with a DSF of 62 percent in Sweden. Sørensen (2014) sets up a simple general equilibrium model of

[31] Karreskog & Kupersmidt (2016) provide a critical overview of the municipal equalization system.



(a) Total tax revenues from labour income as a function of the municipal tax rate.

(b) Total employment as a function of the municipal tax rate.

Figure 8: Laffer and employment curves in Sweden with respect to the municipal tax rate

the Swedish tax system. Assuming a compensated intensive margin elasticity of 0.26 but disregarding extensive margin responses, he estimates that a small tax cut on all labour income has a DSF of 33 percent. Two percentage points are attributable to effects on capital income tax bases.

Turning to considering non-marginal changes to municipal tax rates, total tax revenues as a function of the average municipal tax rate, i.e., a Laffer curve, are plotted in figure 8a. The curvature illustrates that the fiscal impact of behavioural responses is increasing with the tax rate when elasticities are constant. The peak of the Laffer curve occurs at 59 percent. The fact that more revenue can be raised from the municipal income tax does of course not imply that this is desirable. Large tax increases would lower living standards for the working population significantly and have a deleterious effect on employment (see figure 8b).

6.5 Tax cuts for high-income earners

As mentioned in the previous section and by Lundberg (2017), Sweden is probably on the wrong side of the Laffer curve for high incomes, meaning that tax cuts are more than self-financing. Even quite large tax reforms could pay for themselves. I consider a reform that would abolish the central government income tax, thereby lowering marginal tax rates by 20 or 25 percentage points and practically implementing a flat tax – only the effects of the phase-in and phase-out of the EITC would remain (see figure 1b). Disregarding behavioural responses, this would have a cost to the exchequer of SEK 38 billion.[32] Including these, revenue would increase by 0.6 billion. This corresponds to a degree of self-financing of 102 percent. Abolishing *värnskatten*, the last five percent of the

[32]The figure stated in the government budget is 61 billion. The difference is explained by consumption taxes and the fact that SLIMM only considers labour income, while central government income tax is also paid by, e.g., pensioners.

central government income tax, is similarly estimated to have a degree of self-financing of 167 percent. Because I assume that the participation elasticity is declining to zero over the income distribution, participation responses to a flat tax reform are calculated to be very small. Income effects do not have a large impact either. The reason, as explained by Lundberg (2017), is that tax cuts in the high-income region only do not increase disposable income by very much and thus do not induce large income effects. This is especially true in Sweden, where many high-income taxpayers earn just slightly more than the threshold for central government income tax.

The SLIMM estimates are slightly lower than earlier calculations using the same intensive margin elasticity: Lundberg (2016a) calculates that a flat tax reform is associated with a DSF of 130 percent and Sørensen (2010) finds that an abolition of värnskatten has a DSF of 185 percent. The difference is mainly explained by the inclusion of income effects in the present model and a lower consumption tax rate. Using the model SWEtaxben, Ericson & Flood (2014) calculate that an abolition of the central government income tax would have a DSF of 56 percent. They also estimate that removing värnskatten would have a DSF of 81 percent. These results are more in line with the low elasticity scenario in SLIMM. Intensive margin elasticities in SWEtaxben are lower than most estimates in the quasiexperimental literature on taxable income responses; see the discussion in section 2.

7 Conclusion

SLIMM is a new microsimulation model developed for the purposes of this paper. When SLIMM is used to analyze tax reforms affecting labour income earners in Sweden, a major difference emerges between taxing low and average incomes on the one hand and high incomes on the other. For reasonable elasticities, tax cuts for the richest million of working Swedes – those who pay central government income tax – would pay for themselves and even increase tax revenue – i.e., the degree of self-financing (DSF) is more than 100 percent. For tax reductions aimed at the remaining four million wage-earners, for example the earned income tax credit, behavioural responses would most likely finance about a quarter of the tax cut. In addition, tax cuts targeted at low-income wage earners only, i.e., working poor policies of the type in place for low-income parents in the United States, are analyzed. In line with previous studies, the conclusion is that such programmes would be quite effective in increasing employment, but would also be associated with negative degrees of self-financing – implying that the revenue loss is even larger when behavioural responses are considered – and thus quite costly. When raising marginal tax rates across the board, by, e.g., reducing municipal tax rates, behavioural responses are likely to erase just under half of the mechanical revenue gain.

These results are important for policy because labour income makes up approximately two-thirds of GDP and most taxes are in the end taxes on labour. Both payroll and consumption taxes, in addition to direct taxes, drive a wedge between social and private returns to work. Calculations in this paper show that the effective average tax rate on labour income is 45 percent after income-dependent social insurance benefits have been subtracted. For high-income earners, the effective marginal tax rate is at most 75 percent. A key insight in tax theory is that the importance of behavioural responses increases with the tax rate. Because tax rates in Sweden are substantial at all income levels, even when elasticities are modest – the medium scenario in SLIMM uses an aggregate uncompensated elasticity of 0.3 on average and many papers find elasticities that exceed even the high scenario – behavioural responses can have significant fiscal consequences.

In addition, SLIMM is conservative in the sense that behavioural responses are probably somewhat understated. The long-term impact on human capital accumulation and the like are not considered. The same holds for group-level responses, such as wage formation. The choice of consumption tax rate, the level of non-work benefits for low-skill earners and the exclusion of certain benefit systems that affect the marginal return to working operate in the same direction. At the same time, it should be noted that SLIMM does not model labour demand or intra-household linkages. In future work, it would be interesting to model more dimensions of heterogeneity and different types of behavioural responses, such as income shifting.

SLIMM serves as a complement to the one existing labour supply model, the discrete choice model SWEtaxben, mainly because it uses exogenous elasticities rather than elasticities generated within the model. This connects SLIMM's simulations to the quasi-experimental literature and allows robustness checks using different elasticities. At the same time, SWEtaxben features greater heterogeneity of individuals and models the tax and benefit system in more detail. Since SWEtaxben elasticities are endogenous to the dataset used, it is difficult to pin down the magnitude of behavioural responses exactly. In general, however, SLIMM and SWEtaxben seem to generate similar extensive margin responses – for example, when predicting the employment effects of the EITC. On the intensive margin, SWEtaxben elasticities appear to be lower. This is seen most clearly when evaluating changes affecting high-income earners.

It might seem myopic to focus on fiscal measures such as the degree of self-financing, but these can also be given a broader interpretation – at least when considering small tax reforms. Disregarding income effects, the behavioural revenue loss is exactly the increase in excess burden (deadweight loss) caused by a marginal tax hike. This is because the individual's utility is unaffected by her own behavioural responses to a small tax reform, by the envelope theorem. The only first-order effect of behavioural responses is on government revenue. (Sørensen, 2014) The role of income effects is subject to debate. Hendren (2016) and Jacobs (2016), among others, argue that income effects should be included when quantifying the social costs of taxation, beacuse it is the impact on tax revenues that matters. In any case, income effects lower degrees of self-financing by only five to ten percentage points for the tax reforms evaluated here (see medium scenario in table 5).

Although degrees of self-financing (with or without income effects) capture the efficiency gains brought about by tax cuts, it is not necessarily the case that a tax cut with a higher DSF is more desirable (except if it is higher than 100 percent, in which case it should always be desirable). Inequality-averse policymakers will require higher degrees of self-financing for tax cuts that benefit high-income individuals. Because the marginal utility of such individuals is probably lower, larger efficiency losses are tolerated when taxing them. For tax cuts targeted at low-income workers, for example US-style EITC programmes, policymakers might accept negative degrees of self-financing. Which tax reforms are desirable depends on how one weighs equity against efficiency. The results reported in this paper are an aid in this trade-off.

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Appendix

Consumption taxes by decile

In the simulations, I assume that the average tax rate on consumption is the same across the entire income distribution. In order to test this assumption, I calculate consumption tax rates from Statistics Sweden's household survey of consumption patterns, HUT (*hushållens utgifter*). Data on consumption by income decile is available as a pooled average for the years 2007–2009. The sample size is 6,421.

Note that households are ranked by total household income, which implies that households with higher income are considerably larger. With this caveat in mind, we see in table 6 that the average tax rate appears to increase from about 15 percent to 18 percent in the lower half of the income distribution, while it is quite flat at 19 percent in the upper half. The lower tax rates at the bottom are explained to a large extent by greater spending on zero-rated goods – primarily rent. The consumption-weighted average is 18 percent. As the upper half of households are responsible for three quarters of consumption, and probably an even larger share of the consumption of the working population, the assumption of a constant consumption tax rate seems to be a decent approximation.

All tax rates are expressed as a proportion of the retail price. Thus the VAT rates of 6, 12 and 25 percent correspond to 5.7, 10.7 and 20 percent of the post-tax price. Average tax rates on electricity and petrol have been obtained from the Association of Swedish Electricity Utilities and the Swedish Petroleum and Biofuel Institute, respectively. Tax rates on alcohol and tobacco have been calculated by dividing total tax revenue by total consumption in the national accounts in 2014. Note that the mapping of consumption categories into tax rates is not perfect; e.g., the petrol category refers to all expenses associated with operating an automobile.

Table 6: Average tax on consumption by household income decile in Sweden in 2007–2009

Decile	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Tax rate**
Zero-rated goods*	33%	38%	31%	31%	27%	24%	22%	21%	21%	18%	0%
Public transport**	11%	9%	9%	9%	9%	10%	10%	9%	10%	11%	5.7%
Food	20%	17%	19%	18%	18%	17%	18%	18%	17%	18%	10.7%
Electricity	4%	4%	4%	4%	4%	4%	5%	4%	4%	4%	50%
Petrol	5%	6%	7%	8%	8%	10%	9%	9%	9%	8%	66%
Alcohol	1%	1%	2%	2%	2%	1%	1%	1%	1%	1%	57%
Tobacco	1%	1%	1%	1%	1%	1%	1%	1%	1%	0%	64%
All other goods	25%	24%	27%	27%	31%	33%	34%	36%	37%	39%	20%
Average tax rate	14.6%	14.7%	16.4%	17.0%	17.8%	18.8%	18.9%	19.1%	18.6%	18.7%	18.2%
Household size	1.2	1.2	1.4	1.7	1.8	2.2	2.6	2.9	3.1	3.2	
Per capita income***	62	113	128	129	146	142	144	153	170	271	

* Insurance, union dues, childcare, healthcare, rent, interest and property and vehicle taxes
** Plus books, newspapers and hotel stays
*** In thousands of SEK per year

Source: Statistics Sweden, author's calculations.

Table 7: Social security contributions in 2017

Constituent fee	**Swedish name**	**Tax rate**	**Benefit**	**Cap***
Employer's social contributions	*Arbetsgivaravgifter*	*31.42%*	*22.89%*	*Various*
Old-age pension	Ålderspensionsavgift	10.21%	10.21%	496,300
Survivor's pension	Efterlevandepensionsavgift	0.7%	–	n/a
Sick leave	Sjukförsäkringsavgift	4.35%	6.16%	336,000
Parental leave	Föräldraförsäkringsavgift	2.6%	2.97%	448,000
Accident insurance	Arbetsskadeavgift	0.2%	–	n/a
Unemployment insurance	Arbetsmarknadsavgift	2.64%	3.54%	300,000
General wage fee	Allmän löneavgift	10.72%	–	n/a
Employee's pension fee	*Allmän pensionsavgift*	*7%*	*7%*	*496,300*

* Annual earnings ceiling for social security benefits, in SEK.

Social insurance benefits

This section presents a simple method for estimating the effect of social insurance benefits on effective marginal tax rates. Table 7 shows the fees that constitute the employer's social security contributions and which, from a legal perspective, finance the Swedish social insurance systems. The table also shows the caps after which additional income no longer yields greater benefits.[33]

The most important social security benefit is the public pension. The employer contributes 10 percent of the salary and the employee contributes 7 percent. However, the employee's pension fee is only nominal as it is fully offset by a tax credit.[34] The fee payments (up to the earnings cap) are deposited into the individual's pension account, and it is assumed that these mandatory retirement savings are substitutes for cash wages. It should be noted, however, that the majority of the individual's pension account only grows at the same pace as the average Swedish wage, while a private retirement account would grow in line with the presumably higher (but riskier, and taxable) returns on financial markets. In addition, low-income earners are guaranteed a minimum pension, implying that higher earnings at the margin will not translate into higher disposable income in retirement.

Survivor's pension mainly refers to widow's pension, which is only available to women married before 1990. For the majority of today's wage earners, the survivor's pension fee is thus not associated with a future benefit.

The sickness, parental leave and unemployment insurance fees, which are 10 percent in total, are only meant to finance their respective benefits on an aggregate level.[35] To compute the benefit component, an actuarially fair insurance premium is calculated by dividing total revenue from the fee concerned by total income up to the relevant earnings cap. The estimated benefit component is higher than the fee because fees are paid also on the parts of income that exceed the benefit cap. Note that this method ignores the presence of minimum benefit levels (earnings floors), which works in the opposite direction.

[33] Some of the caps are income- or price-indexed. See Lundberg (2016b) for details on the indexing.

[34] I ignore the fact that those with very low incomes – up to about SEK 60,000 per year – do not pay enough tax to make use of the full pension fee tax credit.

[35] By law – *lagen (2000:981) om fördelning av socialavgifter* – revenues from each fee shall be set to correspond to certain income-dependent benefits (including some administration costs). The general wage fee – a pure tax – is then adjusted to bring the total to 31.42 percent.

For each type of social insurance j (unemployment insurance, sickness insurance or parental leave), the fee is denoted by s_j (the third column in table 7), the earnings cap by c_j (fifth column), the replacement rate by ρ_j and the ratio of beneficiaries to taxpayers by λ_j. The individual's income if she becomes unable to work is therefore $\rho_j \min(z, c_j)$. Assuming that λ_j is also the risk that an individual will be in state j, the actuarially fair insurance premium is $\rho_j \lambda_j \min(z, c_j)$. The benefit component $\rho_j \lambda_j$ (the fourth column in table 7) can be computed as follows:

$$s_j \sum_i z_i = \rho_j \lambda_j \sum_i \min(z_i, c_j) \Rightarrow \rho_j \lambda_j = \frac{s_j \sum_i z_i}{\sum_i \min(z_i, c_j)}, \tag{16}$$

where i indexes individuals. This exercise is likely to overestimate benefits for higher-income earners and vice versa for those with lower incomes, as lower-income people are more likely to be unemployed or on sick leave. Note that the benefit component only applies up to the relevant earnings cap.

In total, it is estimated that 73 percent (22.89 out of 31.42 percent) of social security contributions are associated with benefits for low- and medium-income earners. Adding the employee pension fee, total benefits are 30 percent of income, which corresponds to 95 percent of the employer's social contributions. Due to the reasons discussed above (e.g., the presence of benefit floors), this may be a slight overestimation.

A number of previous estimations of the benefit component of social contributions have been made. Flood et al. (2013, p. 35) find a benefit component of 60 percent, while Sørensen (2010, p. 211) arrives at 100 percent "as a very rough approximation". The Swedish Ministry of Finance (1989, p. 63) calculated the benefit portion to be 40 percent, although it should be noted that the new pension system that was implemented in 1999 strengthened the connection with benefits. The calculations in this section are thus closest to those of Sørensen. However, the studies cited fail to account for the fact that earnings caps vary. This variation affects the effective marginal tax schedule in important ways. Only 15 percent of workers hit the ceiling for pensionable income, while half earn more than the unemployment insurance earnings cap.

Robustness to assumptions about out-of-work benefits

There is some uncertainty surrounding the impact of the benefit system on the fiscal effect of participation responses. One reason for this is that it is average benefits among all who are out of work that are observed, rather than average benefits among those who are at the margin of entering employment. In addition, out-of-work benefits are a little too low for low-skill individuals, for technical reasons (see section 5.5).

As a robustness check, table 8 shows how the part of the degree of self-financing that is attributable to extensive margin responses changes when out-of-work benefits are different from the levels shown in figure 6b. The magnitude of behavioural responses is not altered in this exercise, only the budget impact for a given change in employment. As a first robustness check, the table shows results for when all benefits are set to zero, i.e., only the effect on tax revenues is included. Second, the table shows results for when benefits after consumption taxes are set to SEK 100,000 per person and year. In the main analysis, benefits are at most SEK 65,000 per year (see equation 12).

Table 8: Contribution of the extensive margin to the degree of self-financing depending on the benefit level

Reform	**No benefits**	**Benefits as in model**	**High benefits**
Low elasticity scenario			
EITC	7%	10%	12%
US-style EITC	6%	10%	19%
UK-style PA*	6%	8%	12%
Higher municipal tax	5%	7%	8%
Flat tax	0%	1%	1%
Värnskatten	0%	0%	0%
Medium elasticity scenario			
EITC	21%	28%	37%
US-style EITC	17%	29%	56%
UK-style PA*	17%	25%	35%
Higher municipal tax	14%	20%	24%
Flat tax	2%	2%	2%
Värnskatten	0%	0%	0%
High elasticity scenario			
EITC	35%	47%	60%
US-style EITC	28%	46%	87%
UK-style PA*	28%	41%	57%
Higher municipal tax	25%	34%	41%
Flat tax	4%	5%	5%
Värnskatten	0%	0%	0%

* Personal allowance

Note: The middle column shows the contribution of extensive margin responses to the DSF as specified in table 5. The other two columns show a robustness check where benefits have been set to zero and SEK 100,000 per year, respectively.

The magnitude of out-of-work benefits affects the analysis of the American-style EITC the most. Disregarding benefits lowers the DSF by 12 percentage points in the medium scenario, while considering high benefits raises the DSF by 27 percentage points. In the main analysis, the benefit system adds about 7 percentage points to the DSF of the Swedish EITC. The analysis of municipal tax changes is not affected as much by the assumption about benefits. Participation effects matter very little for the analysis of high-income taxation, and the small effect that exists is mostly due to changes in tax revenue, not benefit outlays.

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ISSN 1653-6975