The optimal long-run Earned Income Tax Credit System

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February 2016[1]

JEL Classification Numbers: H21, H24.

Key Words: Earned Income Tax Credit, From Welfare to Work.

The Earned Income Tax Credit (EITC) became a prominent social tool especially in the US where the maximum federal credit reaches 45 percent of the wage. In this paper we ask the following question: assuming that in the long-run From Welfare to Work Program succeeds in increasing the propensity to work by the Working Poor; what is the optimal combination of EITC and transfers to the unemployed? Will the optimal EITC increase or decrease in the long-run? For this purpose we add to Saez (2002) seminal contribution an endogenous elasticity of labor participation. The addition of this feature can be compared to the sensitivity analysis conducted in Saez's simulations, in which he examined how different (exogenous) levels of the extensive margin elasticity affect the respective magnitudes of the EITC and guaranteed income. Like Saez, we find that (in most cases), a higher extensive margin elasticity yields a higher EITC and lower guaranteed income. However, we find that with an endogenous extensive margin elasticity this effect is much weaker, and in some cases it is even reversed, due to the fact that in the endogenous case a high extensive elasticity is obtained when low income individuals have a high labor aversion, and thus the initial share of unemployed individuals is larger relative to the working poor - which makes the EITC a less attractive tool for the policy maker. Our simulations show that when the initial share of working poor is small enough relative to the unemployed the expected long run reduction of labor aversion produces an increasing optimal EITC, whereas in the case in which the initial proportion of the unemployed is low relative to the working poor, the reduction of labor aversion produces a decreasing optimal EITC.

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The optimal long-run Earned Income Tax Credit System

By Eitan Regev and Michel Strawczynski

1. Introduction

While the Earned Income Tax Credit (EITC) became the main policy tool in the US for incentivizing persistent working poor's participation at the labor market[2], its analytical characterization is scarce. The most prominent analytical paper was written by Saez (2002), who showed that the appropriateness of implementing the EITC is enhanced by high working poor's extensive-margin elasticity, which favors providing him a wage subsidy over an allowance to the non-participating poor. However, Saez (2002) did not model directly the participation decision by the working poor, which is related to heterogeneous leisure preferences by different individuals. In this paper we build a model of the optimal EITC with heterogeneous tastes for leisure, in order to obtain an insight about the nature of the extensive-margin elasticity. Identifying the driving forces of this elasticity is crucial for characterizing the optimal EITC schedule.

Another remarkable point of the EITC system from the point of view of policy makers, is that its main goal is providing incentives for *persistent* participation at the labor market, as a mean for allowing the working poor to fight poverty on a permanent basis through his labor market compensation, as opposed to a situation in which he depends on government transfers like child allowances or income maintenance. In fact, the EITC became the most prominent tool of the approach

[2] In the federal system at the US the maximum subsidy at the top of the EITC trapeze is 45 percent of working poor's wage.

adopted by many OECD countries known as "from welfare to work". Under this approach, one of the main purposes of the policy makers has been to embed working ambitions and abilities among the working poor. By persistently keeping the working poor at the labor market, he is supposed to experience by himself the advantages of the labor market as a mean for escaping poverty and for establishing a tradition that will be passed on to the next generation. In fact, many papers have documented the pros and cons of different welfare mechanisms as tools for improving the prospects of the working poor's long-term participation.[3] However, none of these papers has analyzed the optimal EITC when evolving to the long-run equilibrium of working poor's increased participation: note that as long as the poor remains at the labor market, his aversion to labor shall decrease over time. In this paper we analyze the optimal EITC in a world where the working poor changes his tastes, toward the long-term objective of the government – i.e., his labor aversion declines over time.

The paper is organized as follows. In the next section we survey the literature in two aspects: papers that analyzed the optimality of the EITC, and papers that studied the impact of welfare programs on the persistence of labor market participation by the working poor. Section 3 introduces a model with heterogeneous tastes for leisure, and analyzes the dynamics of labor aversion in the long-run, in a world in which the government implements policy tools for reducing the working poor's labor aversion. Section 4 introduces heterogeneous tastes for leisure into an optimal EITC model along the lines of Saez (2002). We provide simulations of the optimal EITC, which

[3] See f.e. Freedman, Friedlander, Hamilton, Rock, Mitchell, Nudelman, Schweder and Storto (2000) who evaluate the two-years effect of eleven Welfare to Work programs.

results from changes in individuals' tastes toward a reduction of labor aversion over time. Section 5 summarizes and concludes.

2. Literature Survey

One of the pioneering papers on the issue of the desired government policy for implementing the right incentives for enhancing working poor's participation at the labor market was written by Besley and Coate (1992). They show that when the government has no information about the true tastes and about the abilities of individuals, a combination of welfare payments, and a minimum required amount of work, are both needed as part of the optimal policy package.

In order to implement this type of solution the main tool that has been used in OECD countries in general, and in the US in particular, is the EITC. Saez (2002) wrote the first paper that analyzed the optimality of the EITC, in a model that compares the optimal government policy toward the working poor, among two alternatives: receiving a welfare payment, that is not subject to labor market participation, versus receiving an Earned Income Tax Credit, that is contingent on participation at the labor market. Saez (2002) solves an analytical model that has two kinds of elasticities: the extensive-margin elasticity summarizes the reaction of individuals in terms of participation at the labor market, while the intensive-margin elasticity summarizes his reaction in terms of the share of time he dedicates to work (i.e., his job partiality). The first type of elasticity is crucial for the optimality of an EITC system: the higher is the extensive-margin elasticity, the more effective is the EITC subsidy for keeping individuals at the labor market.

Another important aspect of the Welfare to Work approach is whether the adopted policy tools are the right ones for allowing persistent participation at the labor market by the working poor, in the most cost effective manner.

Pavoni and Violante (2007) show that the help to the working poor shall include social assistance, unemployment insurance, job monitoring and wage subsidies. Pavoni, Setty and Violante (2015) model welfare-to-work programs as contracts offered by the government to unemployed agents in an environment with moral hazard. According to their paper the generosity of the program depends on the skilled level of the unemployed agent, and they show that it is possible to adopt "soft" programs (i.e., with absence of punishments) that avoid hidden savings by the unemployed.[4]

After the adoption of the Personal Responsibility and Work Reconciliation Act implemented in the US in August 1996, many evaluation reports have been written with the purpose of evaluating the effectiveness of the different programs for improving working prospects by the working poor. These studies show that the outcomes are fairly explained by the details of the different programs. Freedman et al. (2000) show that employment-focused programs increased participation primarily in job search activities, whereas education-focused programs raised participation levels primarily in basic education and vocational skills training classes. They also found that employment-focused programs produced larger gains in employment and earnings over the two-year follow-up period than education-focused programs, but these effects may not be sustained everywhere in the long run. One of the best

[4] When there is substantial misreporting, workfare may become a socially desirable contract, as shown by Blumkin, Margalioth and Sadka (2013).

performers was the Portland's Program, which was evaluated by Scrivener et al. (1998). This program provided job search assistance to a large segment of their caseload and encouraged enrollees to find work as quickly as possible. While all regional programs were benefited by the implementation of the federal EITC, the Portland program further employed full-time job developers to help place program enrollees in unsubsidized jobs. Its employment message was strong, and the program offered high-quality education and training services as well as job search; it also enforced a participation mandate, and had strong job development and placement services. In addition, contextual factors may have contributed to the program's success: it worked with a less disadvantaged welfare caseload and operated within a good labor market with a relatively high state minimum wage.

Persistent participation and decreasing labor aversion

An important finding from the point of view of the present paper was shown by Hamilton, Freedman, Gennetian, Michalopoulos, Adams-Ciardullo and Gassman-Pines (2001): they show that all three human capital development programs (HCD) increased participation over the control group in a higher extent for the 5-years period compared to the 2-years period. This finding hints that there is a long-term impact on participation, an issue that is at the heart of our paper.

(Riccio, Friedlander and freedman, 1994) evaluate the three-year Impacts of GAIN – a welfare-to-work program that was initiated in California in the late 80's and was the largest scale program of its kind in the US. The program was found to have significant effect even three years after participation. It substantially increased participation in job search and basic education, and it reduced the proportion of experimentals who were on government support during the last quarter of year 3 by 3%.

(Dyke et. Al, 2006) use administrative data on Missouri and North Carolina welfare recipients, and employs improved estimation approaches to identify the distinct effects of each state's welfare-to-work subprograms. They find that more intensive training is associated with greater initial earnings losses but also greater long-run earnings gains. The negative program impacts that are observed in quarters immediately following participation turn positive by the second year after participation.

Autor and Houseman (2010) use data from Detroit's welfare-to-work program to identify the effect of temporary-help jobs on labor market advancement. They find that temporary-help job placements do not improve and may diminish subsequent earnings and employment outcomes, while job placements with direct-hire employers substantially raise earnings and employment over a seven quarter follow-up period. This finding suggests that persistent job placements, as opposed to temporary ones, allow individuals to learn capabilities that are worthy for employers at the labor market. In our model this learning process takes the form of a reduction of labor aversion.[5]

[5] Another possible interpretation is that the hourly wage of individuals goes up. However, evidence show that the impact of policy tools on wages of low-skilled individuals takes a long time, and thus for the purpose of this paper we believe that our approach is more realistic..

3. A model with endogenous extensive margin elasticity

3.1 The Model

Assume that individuals have tastes for consumption and leisure, represented by (1-α_i) and α_i respectively[6]:

1) $U_i(c, 1-l) = (1-\alpha_i)\ln(c_i) + \alpha_i \ln(1-l_i)$

Where (1-l) represents leisure. Assuming that the government intervenes with the aim of re-distributing income, through a demogrant T_0 and a piecewise linear income tax $t_i = 1 - \beta_i$, the budget constraint is:

2) $c_i = T_0 + \beta_i w_i l_i$

Where w represents the hourly wage that the worker is paid at the labor market (his marginal productivity) and β is the average tax for the relevant wage. For low wage workers this wage is lower or close to the minimum wage paid in the economy.

At the optimum the individual decides about consumption and leisure. Assuming that λ is the Lagrange multiplier, the F.O.C. is:

$$L_l \to \frac{\alpha}{1-l} = \lambda \beta w$$
$$L_c \to \frac{1-\alpha}{c} = \lambda$$
$$c = \frac{1-\alpha}{\alpha} \cdot (1-l)w$$
$$\frac{1-\alpha}{\alpha} \cdot (1-l)w = lw + T_0$$

Which implies the following solution:

3) $l_i = 1 - \alpha(1 + \frac{T_0}{\beta_i w_i})$, $w_i > w_i^* = \frac{\alpha_i}{\beta_i(1-\alpha_i)} \cdot T_0$

$c_i = (1-\alpha_i)(T_0 + \beta_i w_i)$, $l_i > 0$

[6] Note that since marginal utility of consumption decreases with income, in this case there are income effects. Thus, there is a range of values for which the individual does not participate. We assume that in this case q is lower than the utility associated with participation.

Note that there is a minimum hourly wage, w_i^*, above which the individual participates at the labor market ("participation wage").

Since in this paper we concentrate on the optimal EITC, the extensive margin will play a crucial role. In particular, we will concentrate on the density function:

4) $g(\alpha_i) = f(w_i^* - w_i) = \theta_i \left(\frac{\alpha_i}{\beta_i(1-\alpha_i)} T_0 - w_i\right)$

Where θ is a parameter that translates the gap between the participation and the actual wage to the group density; i.e., the extensive margin elasticity depends on three factors: the distribution of α_i among low income individuals, the magnitude of guaranteed income relative to wages, and the marginal tax rate.

Since empirical research on labor supply overwhelmingly shows that high income individuals have a low (zero) extensive margin elasticity,[7] we will assume that they have low values for α and we will concentrate on the distributions of α and w for low-income individuals. Based on observed economic behavior we assume as a benchmark assumption that the density functions of α and w are decreasing.

For simplicity we will think of a three-point distribution in which there is a high income individual group with a zero extensive margin elasticity, a low income individual group that participates but is close to indifference, and a low-(potential)-income individuals group with high leisure preferences that tends not to participate at the labor market:

$$4')\quad g(\alpha_1, w_{low}) = f(w_1^* - w_{low}) = \theta_1 \left(\frac{\alpha_1}{\beta_1(1-\alpha_1)} A - w_{low}\right)$$

[7] In fact, we show later that our model produces this result in an endogenous manner.

$$g(\alpha_2, w_{low}) = f(w_2^* - w_{low}) = -\theta_2 \left(\frac{\alpha_2}{\beta_2(1-\alpha_2)}A - w_{low}\right)$$

$$g(\alpha_3, w_{high}) = f(w_3^* - w_{high}) = -\theta_3 \left(\frac{\alpha_3}{\beta_3(1-\alpha_3)}A - w_{high}\right)$$

Where:

$\alpha_1 > \alpha_2 > \alpha_3$; $w_{low} < w_{high}$; $g(\alpha_1) + g(\alpha_2) + g(\alpha_3) = 1$; and

w_1^*, w_2^*, w_2^*, are the respective entry wages for individuals with $\alpha_1, \alpha_2, \alpha_3$.

A low α, a high w and a low θ characterize the high-income group. A high α and a low w characterize the low-income group. The middle group has mid-values for α and low wages.

3.2 Long-Run Government Policy

Governments impose the EITC with the purpose of subsidizing wages at low income levels, subject to participation at the labor market. The conditioning of the subsidy upon participation has driven policy-makers to look at the EITC as one of the significant tools within the approach known as "from welfare to work".

Beyond the EITC, additional available tools for governments for incentivizing participation in the long-run include subsidizing daily child care, "advertising" and training courses.

3.2.1 "From Welfare to Work" Program

From Welfare to Work programs (FWTW) are aimed at achieving a persistent participation of low-wage workers in the labor market, which will increase their capabilities in the future through "on the job training" and by potential escalation in the wage scales of jobs. In terms of our model an advertising campaign is aimed at convincing the first group to permanently reduce their α value, which implies a positive attitude for remaining persistently at the labor market. A real-life example for this issue is related to the participation of women as a second earner in societies that were characterized by a traditional family, in which the woman stayed at home with the children as part of household approach, and did not participate at the labor market.[8] Through a FWTW Program governments aim at allowing families to experience a two-earners' situation, which may change the existing prior of the family by experiencing that working is not as problematic as they previously thought. In this example the reduction of α as shown in our model represents actually an increase in families' attitude toward the participation of the second earner at the labor market.

Note that in our three-point distribution this change would translate into a reduction of the density of individuals with labor aversion of α_1. The reduction of this density is compensated by an increase in the number of individuals that become indifferent about participation. That is, θ_1 goes down and θ_2 goes up.

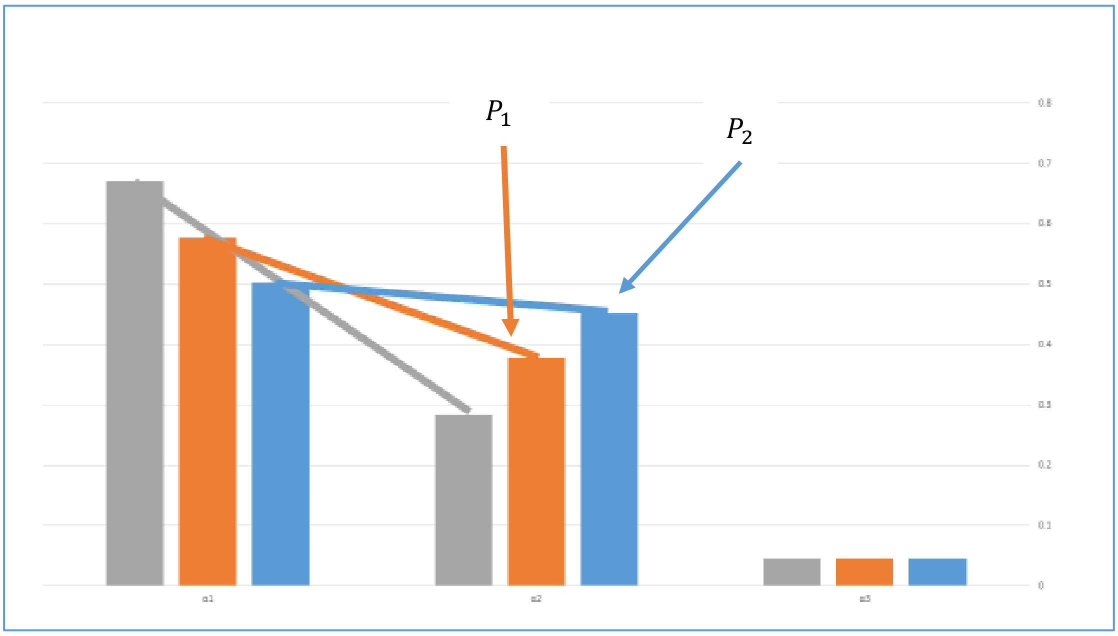
A way to include a FWTW Program in our model would be to look at the change in θ_1 when a successful program (P_2) is implemented, in comparison with a less effective policy P_1 :

$$\theta_1(P_2) < \theta_1(P_1)$$

[8] This feature was characterized in Israel for Arab women, whose participation rate is approximately one-third compared to other families. Yashiv and Kasir (2011) and Eckstein and Lifshitz (2012) studied Arab women attitude toward labor market participation in the context of a traditional family. These authors show that Arab women participation has been changing in the last two decades, at a time when the Israeli government adopted a policy denominated "From Welfare to Work", which included, among other policy tools, a substantial increase in subsidies for child-care institutions.

In Figure 4 we show what happens to the long-run density function when the government successfully implements a FWTW Program, compared to the basic density function.

Figure 4 – Long-Run Density function with labor advertising



We see that the long-run government policy drives the density function from a decreasing function to a uniform density function.

3.2.2 The EITC

Equation 4' allows us to analyze the effect of the EITC. One important question that will be analyzed in the next section is what are the groups that will receive at the optimum an EITC subsidy. In the next section we solve the optimal EITC and show that it is optimal to give transfers to the working poor.

In the above model, the first group represents the unemployed. According to 6' this means that for the first group the EITC could make the difference between participating and not participating; i.e., for a $\beta_1 > 1$ and a $\beta_2 > 1$, we obtain:

$$(4'')\ g(\alpha_1) = f(w_1^* - w_{low}) = \theta_1 \left(\frac{\alpha_1}{\beta_1(1-\alpha_1)} A - w_{low}\right) < \theta_1 \left(\frac{\alpha_1}{(1-\alpha_1)} A - w_{low}\right)$$

$$g(\alpha_2) = f(w_2^* - w_{low}) = -\theta_2 \left(\frac{\alpha_2}{\beta_2(1-\alpha_2)} A - w_{low}\right) > -\theta_2 \left(\frac{\alpha_2}{(1-\alpha_2)} A - w_{low}\right)$$

In words, the EITC transfer implies that the threshold wage goes down and thus the desire of the individual to participate increases, which is translated into a decrease of the term in parenthesis at 4'' – i.e., a reduction of g(α_1). At the same time for the second group the negative term in parenthesis become more negative, which is translated into an increase of g(α_2). Thus, the implication for the long-run density of α is the same as in the case of "From Welfare to Work" Program as a policy tool, and also here the density tends to become uniform.

Note that the individuals who joined the workforce via EITC will now experience the labor market. This experience will reduce in the long-run their α_i. In this particular example according to (4'') α_2 will decline, which implies that g(α_2) will increase. Since $g(\alpha_1) + g(\alpha_2) + g(\alpha_3) = 1$, and $g(\alpha_3)$ does not change, there is a reduction in $g(\alpha_1)$; i.e., also this effect provokes a change that drives the density toward a uniform density function.

4. The Optimal Piecewise linear EITC with endogenous tastes for leisure

4.1 Optimal EITC

In this sub-section we use the model introduced by Saez (2002) in order to characterize the optimal EITC. According to his model there are I branches with a weight that equals to h_i ($\sum_1^I h_i = 1$), each of them representing a different wage level. Each branch is associated by the government with a welfare weight g_i, that altogether average to 1; i.e., for low income levels $g_i > 1$ and for high income levels

$g_i < 1$. Saez (2002) calculated the optimal combination of transfers to the unemployed and EITC when individuals' response is based on both the extensive and the intensive margins. The extensive-margin elasticity is represented by η, and the intensive-margin elasticity is represented by ζ. The intensive-margin elasticity responds to the case in which individuals switch branches – i.e., an increase in taxation may cause an individual to switch from branch I to branch (i-1). His solution for optimal marginal taxes/subsidies (represented by T), for the I industries is the following (note that c represents consumption):

(5) $$\frac{T_i - T_{i-1}}{c_i - c_{i-1}} = \frac{1}{\zeta_i h_i} \sum_{j=i}^{I} h_j \left[1 - g_j - \eta_j \frac{T_j - T_0}{c_j - c_0}\right]$$

Assuming that the participation elasticity (i.e., at the extensive margin) for the third industry onwards equals zero[9], and turning to optimal average tax rates (represented by t), we obtain the following solution (see Appendix A):

(6)

$$t_1 = t_2 \frac{w_2}{w_1} - \frac{w_2 - w_1}{w_1} \cdot \left[1 - \frac{h_2 \zeta_2}{h_2 \zeta_2 + (g_0 - 1)h_0 + (g_1 - 1)h_1 - h_2 \eta_2 \cdot \frac{t_2}{1 - t_2}}\right]$$

$$t_2 = 1 - \frac{h_2 \eta_2}{h_2 \eta_2 + (g_0 - 1)h_0 - h_1(\zeta_1 + \eta_1) \frac{t_1}{1 - t_1}}$$

$$\forall i > 2,\ \ t_i = t_{i-1} \frac{w_{i-1}}{w_i} + \frac{(w_i - w_{i-1})}{w_i} \cdot \left[1 - \frac{\zeta_i h_i}{\zeta_i h_i + \sum_{j=i}^{I} h_j \left[1 - g_j\right]}\right]$$

[9] This assumption was adopted also by Saez (2002). We later show that in our model the zero participation elasticities for branch 3 onwards is obtained endogenously; i.e., the participation decision of individuals from these branches are consistent with a zero participation elasticity .

Note that most parameters appear in both t_1 and t_2 with an impact that goes both up and down, which means that the relationship between the variables is not immediate. Since g_0 is higher than 1, one clear result is that if an EITC is optimal for the first group ($t_1 < 0$), then it will be optimal to impose a tax on the second group ($t_2 > 0$). This is so since the second term in the right hand side of the second equation is lower than 1. Another clear result is that if g_1 goes up, the plausibility of obtaining an optimal EITC transfer for the first group ($t_1 < 0$) increases. Concerning other variables the relationship is not trivial: f.e., increasing g_0 increases the plausibility of obtaining a negative t_1 through the first equation, but it reduces it through the second equation (i.e., t_2 goes up which according to the first equation reduces the plausibility of $t_1 < 0$).

A simpler interpretation of this formula that confirms these results is obtained when $\zeta_2 = 0$. In this case the optimal EITC is:

$$t_1 = t_2 \frac{w_2}{w_1} - \frac{w_2 - w_1}{w_1}$$

$$t_2 = 1 - \frac{h_2 \eta_2}{h_2 \eta_2 + (g_0 - 1) h_0 - h_1 (\zeta_1 + \eta_1) \frac{t_1}{1 - t_1}}$$

Note that for the case in which $t_1 < 0$, the denominator of the right hand side of the t_2 formula is positive, and the quotient is lower than one; i.e., $t_2 > 0$. Note also that a higher participation elasticity of the second branch reduces t_2, which in turn reduces the first term of the right hand side of the $t_1$formula, and thus it increases the optimal EITC for the first branch.

Since for most variables the relationship is not trivial, we will proceed by performing simulations. Before doing so we shall stress two issues.

First, the peculiarity of our model compared to Saez's analysis, is that we emulate the extensive-margin and the intensive-margin elasticities using the model presented in section 3. Optimally, we would solve an optimal social planner problem plugging optimal individual's decision shown in equation (3) into the social welfare function, to be maximized subject to the government budget constraint. However, the solution of such a model implies a multiplicity of optimal taxes, which makes it intractable. In fact, this model can be solved analytically only in restricted cases.[10]

Second, in equation 13,[11] Saez (2002) shows that it is possible to change the interpretation of the intensive-margin elasticity, that is associated in his model to switching branches. This equation allows the use of the standard interpretation for the intensive-margin elasticity; i.e., it represents changes in effort (or job partiality). Similarly to equation 13 in Saez (2002), we adopt this interpretation by using ε instead of ζ, where the former is the standard labor intensive-margin elasticity. Apart from the introduction of an endogenous extensive margin elasticity, our simulations follow the methodology of Saez's simulations – implemented on data from the Israeli incomes end expenditures survey of 2012 (see appendix).

4.2 Simulations Methodology

In Appendix C we show in detail the simulation assumptions. Following we describe some of the main variables.

[10] One tractable case would be to consider a Rawlsian planner that maximizes the transfer to the unemployed, as in Strawczynski (2014). However, in the present context this case is not relevant because it excludes ex-ante the optimality of an EITC subsidy, which is the focus of this paper.
[11] See Saez (2002), page 1070.

4.2.1 Distribution of labor aversion α_i in each wage group

In order to obtain an endogenous extensive margin elasticity, we assume that individuals in each (potential) wage group w_j vary in their leisure preferences, α_i[12]. This means that in each group some individuals are more leisure-loving than others. For simplicity, we assume that α_i is distributed uniformly in each group (but the distribution range can differ in different groups). In the simulations we assume that for (potential) wage groups $w_3 - w_{11}$, the middle, and the higher income groups, $\alpha_i \sim [0,0.5]$. For the lower income groups, w_1, w_2 we initially assume that $\alpha_i \sim [0.5,1]$, and then introduce several sensitivity analyses, in which the α_i range of these groups gradually shifts to a less labor averse composition: $\alpha_i \sim [0.1,0.9]$. This sensitivity analysis is designed to imitate a learning process, in which low income individuals gradually become less leisure-loving and more inclined to work. It also imitates an exogenous change in the extensive margin elasticity – corresponding to the sensitivity analysis conducted in Saez's simulations.

4.2.2 The Extensive margin elasticity

Unlike in Saez (2002), the extensive elasticity in our model is endogenous, as income effects are factored in. The extensive elasticity η_i is defined in our model as the ratio between the percentage change in the size of a group N_i given a one percent change in w_i.[13] Recall that the individual's labor decision depends on the ratio between guaranteed unemployed income and wages, $\frac{T_0}{w_i}$, as well as on the individual's

[12] This assumption is quite plausible since it is also observed empirically that some low wage individuals work, and some (potential) low wage individuals do not. To assume that they all have the same α_i would be equivalent to assuming that all low wage individuals either work or do not work – which would contradict the empirical evidence.

[13] For the purpose of the simulations, and given that this is a realistic estimate that produces stable results, we plugged in a 15 percent change in income which roughly corresponds to the optimal EITC obtained in the simulations.

leisure preferences α_i, as demonstrated in equation (3) $l_i = 1 - \alpha\left(1 + \frac{T_0}{\beta_j w_j}\right)$. Deriving (3) with respect to w_i provides better insight regarding the factors that determine the magnitude of the (endogenous) extensive elasticity: $\frac{\partial l_i}{\partial w_j} = \frac{\alpha_i T_0}{\beta_i {w_j}^2}$. Saez's simulations assume that the extensive elasticity is exogenous but this ignores the fact that, when all else is equal, a higher extensive margin elasticity means a distribution of α_i that is more skewed towards high values. In other words, the extensive elasticity η_i can only be high when a large share of the (potentially) working poor are unemployed, and therefore the potential of entry is higher. Saez's simulations do not take into account the fact that when a larger share of the population is labor averse, more people are unemployed and thus the potential of bringing people into the labor market is greater (percentage-wise).

This leads to two effects that almost cancel each other out – the higher extensive elasticity leads to a higher EITC but this coincides with a smaller share of working poor which leads to a smaller EITC. The former is usually stronger, but only by a little. Thus an interesting result occurs – the government actually gives a slightly higher guaranteed income and lower EITC when the share of working poor is larger. This is due to the fact that more public resources are available (for guaranteed income) when more people work. Thus the magnitude of the endogenous extensive elasticity increases with T_0 and α_i and diminishes with w_j. In other words, people with low wages, high leisure preferences, and high levels of guaranteed income, have the highest participation elasticity (provided that they are close enough to entry wages). Note that a rise in the level of guaranteed income T_0, causes the extensive elasticity

η_i to go up due to the rise in the $\frac{T_0}{\beta_i w_i}$ ratio. But since individuals in each wage group vary in their leisure preferences (within the group specified α range), when T_0 rises leisure-loving individuals leave the workforce, and the entry-level α_i drops (i.e. only workers with lower labor aversion work), and this slightly offsets the rise in η_j.

4.3 Results

Following we show the results of the simulations for two cases: logarithmic and constant risk aversion utility functions. Before doing so, we compare Saez's results to our case, in which the extensive elasticity is endogenous.

4.3.1 Comparison to Saez (2002)

The (exogenous) decline in labor aversion in our simulations, which yields lower levels of (endogenous) η can be compared to an exogenous decline in η in Saez's simulations. The main difference between the two cases is that in our case in order to obtain a low extensive margin elasticity the labor aversion must go down, which has many other additional implications for calculating the optimal EITC. In Table 1 we show a comparison between cases that have a similar extensive margin elasticity (the detailed simulation appears below).

In both cases the lower η yields lower EITC and higher guaranteed income. However, in our simulations this effect is much weaker: we see in the first row that it goes down from 8.5% to 7.9%, while a similar change in the extensive margin elasticity in Saez's simulations implies a change from a 23% subsidy to a 7% tax. This is due to the fact that in our simulations the lower η is obtained via lower labor aversion α_i, which implies that in the initial state more low wage individuals are working – which raises h_1 and partially offsets the negative effect of a smaller η on the magnitude of the EITC. A similar pattern was obtained for all cases in which the extensive margin elasticity goes down from a value that is approximately 1 to approximately 0.5.

Table 1: A comparison to Saez (2002)

Optimal tax (extensive margin elasticity in parenthesis)		Reference
Simulation in Saez (2002)		
-23 (1)	7 (0.5)	Table 1
-8(1)	37 (0.5)	Table 1
-2 (1)	45 (0.5)	Table 1
-5 (1)	12 (0.5)	Table 2
Our Simulations		
-8.5 (0.94)	-7.9 (0.42)	Table 2
-9.6 (1.09)	-9 (0.49)	Table B.2
-8.2 (1.0)	-7.9 (0.56)	Table B.3

While in the cases shown in Table 1 our results go the same direction but are weaker in their extent, we show later a case in which the direction of the result maybe even reversed (i.e., a lower extensive margin elasticity implies a higher optimal subsidy).

4.3.2 Logarithmic utility function

In Table 2 we show the simulation results for the case in which utility is logarithmic, and the intensive margin elasticity is exogenous: $\varepsilon_{\mathrm{low}}$=0, $\varepsilon_{\mathrm{high}}$=0.25. This case is based on the benchmark assumption concerning the funds used for public good finance. Three sensitivity analyses, concerning the starting value of α and the budget constraint[14], are shown in tables B.1, B.2 and B.3 in Appendix B.

Two interesting results arise from Table 2. First, the optimal EITC starts from high values, 8.5 percent, but it vanishes as the income inequality aversion goes up (i.e., higher v values). For a medium value of income inequality aversion the optimal EITC goes down to 2.2 percent, and it turns to a tax for v=0.25. This result is similar to the one obtained by Saez: for a liberal government ($g_0 > g_1$), the higher is the inequality aversion, the higher is the transfer for the unemployed which implies an optimal negative income tax as opposed to an EITC. Second, as the range of α increases to allow a reduction of its mean, the extensive margin elasticity of the working poor is reduced, causing a decrease of the optimal EITC. This result is new and has an important implication: if the policy maker aims at increasing participation by using an EITC, the more successful this policy is, causing a persistent increase in participation - which further reduces long-run labor aversion -, the lower will the EITC transfer be in the long-run. Similar results can be seen at appendix B for different values of the budget constraint and the starting α, in tables B.1, B.2 and B.3.: those simulations include an optimal declining EITC (and even turning into a tax) as long as inequality aversion goes up, and as long as the range for α increases. Note that a lower amount used for the public good (20,000 instead of 25,050 as in Table 2) implies a higher amount available for transfers, which implies that the transfer that is given to the unemployed is higher, reducing the optimal EITC.

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[14] In the simulations the benchmark figure for the public good (25,050), reflects a transformation from annual direct tax revenues in Israel, into monthly terms, as used in the simulation. Thus the tax annual revenue figure of 95.15 billion NIS was divided by (12*121.3*2609.9), where 12 is the number of months in a year, 121.3 is the ratio between the Israeli 2012 workforce and the simulation population, and 2609.9 is the actual monthly wage of the bottom wage group (which in the simulations was normalized to 1).

Table 2: Optimal EITC with a 0.25 intensive-margin elasticity

(Public Good=25,050, ε_{low}=0, $\varepsilon_{\text{high}}$=0.25, lowest α_i for low incomes = 1)

Distribution of α_i in low income groups	Outcome Reported	v=0.15			v=0.20			v=0.25		
		w1	w2-w6	w7-w11	w1	w2-w6	w7-w11	w1	w2-w6	w7-w11
		0-4500	4500-10000	6700-40000	0-4500	4500-10000	6700-40000	0-4500	4500-10000	6700-40000
α_i ~ U(1,0.5)	Average tax rate	-8.5%	54.4%	58.8%	-2.2%	58.4%	63.9%	3.8%	61.7%	67.7%
	Average m.t. rate	-8.5%	83.4%	53.8%	-2.2%	86.8%	60.1%	3.8%	89.0%	64.7%
	avg. job partiality	16.7%	57.9%	71.3%	14.3%	57.4%	69.9%	12.3%	56.9%	68.7%
	normalized partiality	29.6%	103.0%	126.8%	25.5%	102.1%	124.3%	21.8%	101.2%	122.1%
	H	10.71%	36%	36%	8.62%	34%	36%	6.98%	33%	36%
	avg. η	0.937	0.086	-	1.202	0.088	-	1.433	0.083	-
	Non-Employment %	17.9%			21.4%			24.1%		
	Guaranteed income (% of lowest income)	36.2%			43.6%			49.0%		
α_i ~ U(1,0.4)	Average tax rate	-8.3%	54.1%	58.7%	-1.9%	58.2%	63.9%	4.1%	61.5%	67.6%
	Average m.t. rate	-8.3%	83.2%	53.7%	-1.9%	86.6%	60.0%	4.1%	88.9%	64.5%
	avg. job partiality	23.2%	58.1%	71.3%	21.3%	57.1%	69.9%	19.7%	56.2%	68.6%
	normalized partiality	41.3%	103.3%	126.7%	37.9%	101.6%	124.2%	35.0%	99.8%	121.9%
	H	12.41%	37%	36%	10.64%	36%	36%	9.26%	35%	36%
	avg. η	0.662	0.076	-	0.805	0.080	-	0.916	0.081	-
	Non-Employment %	15.0%			18.0%			20.3%		
	Guaranteed income (% of lowest income)	36.6%			44.1%			49.6%		
α_i ~ U(1,0.3)	Average tax rate	-8.2%	53.9%	58.6%	-1.8%	57.9%	63.8%	4.4%	61.3%	67.6%
	Average m.t. rate	-8.2%	83.1%	53.6%	-1.8%	86.5%	59.9%	4.4%	88.8%	64.4%
	avg. job partiality	29.9%	58.9%	71.2%	28.4%	57.6%	69.8%	27.1%	56.4%	68.5%
	normalized partiality	53.1%	104.7%	126.6%	50.5%	102.5%	124.1%	48.2%	100.3%	121.8%
	H	13.63%	38%	36%	12.09%	37%	36%	10.88%	36%	36%
	avg. η	0.516	0.067	-	0.610	0.073	-	0.677	0.074	-
	Non-Employment %	13.0%			15.6%			17.6%		
	Guaranteed income (% of lowest income)	37.0%			44.7%			50.3%		
α_i ~ U(1,0.2)	Average tax rate	-7.9%	53.7%	58.6%	-1.5%	57.7%	63.7%	4.7%	61.1%	67.6%
	Average m.t. rate	-7.9%	83.0%	53.5%	-1.5%	86.4%	59.8%	4.7%	88.7%	64.3%
	avg. job partiality	36.5%	60.0%	71.2%	35.5%	58.6%	69.7%	34.6%	57.3%	68.4%
	normalized partiality	64.9%	106.7%	126.5%	63.2%	104.3%	124.0%	61.6%	101.8%	121.6%
	H	14.51%	38%	36%	13.15%	37%	36%	12.08%	37%	36%
	avg. η	0.424	0.060	-	0.492	0.066	-	0.539	0.068	-
	Non-Employment %	11.5%			13.8%			15.6%		
	Guaranteed income (% of lowest income)	37.6%			45.4%			51.1%		

In Table 3 the intensive-margin elasticity is 0.5 (instead of 0.25 in Table 2), which implies that the taxes must be lower, since high-income individuals reduce labor with a higher intensity as a reaction to the imposition of taxes. Consequently, the optimal EITC is lower, since lower resources are available for redistribution. Note that despite this fact the two main results obtained above are still valid: there is an optimal EITC for v=0.15 and v=0.2, and it goes down as the range for α increases. While these results remain similar for lower amounts of the public good when the starting α is either 1 or 0.9 (Table B.5 and B.6), in the case of a lower starting value of α (0.9 instead of 1) with the benchmark level of the public good (25,050), an optimal EITC is obtained only for v=0.15; for the other two values of v (v=0.2 and v=0.25) it is optimal to impose a tax on the working poor (Table B.4).

An interesting result is obtained when we allow the intensive-margin elasticity to be endogenous – an assumption that departs from Saez's simulations. In this case, which is shown in Table 4, the pattern of the optimal EITC is the opposite: as the working poor increases his labor aversion, represented by an increase in the range of α, the optimal EITC increases. This pattern is related to the interaction between the public good budget requirement and the other variables: it was obtained when the resources used for the public good are equal to 40,000; i.e., there are limited resources for redistribution, which implies a low transfer to the unemployed (T_0). According to our simulations, a low transfer to the unemployed increases the

Table 3 : Optimal EITC with a 0.5 intensive-margin elasticity

Public Good=25,050, ε_{low}=0, $\varepsilon_{\text{high}}$=0.5, lowest α_i for low incomes = 1

Distribution of α_i in low income groups	Outcome Reported	v=0.15			v=0.20			v=0.25		
		w1	w2-w6	w7-w11	w1	w2-w6	w7-w11	w1	w2-w6	w7-w11
		0-4500	4500-10000	6700-40000	0-4500	4500-10000	6700-40000	0-4500	4500-10000	6700-40000
α_i ~ U(1,0.5)	Average tax rate	-7.8%	49.0%	46.4%	-2.6%	53.0%	52.0%	2.5%	56.5%	56.4%
	Average m.t. rate	-7.8%	72.8%	36.8%	-2.6%	77.3%	43.0%	2.5%	80.5%	47.8%
	avg. job partiality	23.3%	58.4%	74.4%	21.8%	58.4%	73.8%	20.6%	58.4%	73.3%
	normalized partiality	41.5%	103.9%	132.3%	38.8%	103.9%	131.3%	36.7%	103.8%	130.3%
	H	18.75%	41%	36%	16.63%	40%	36%	15.05%	39%	36%
	avg. η	0.169	0.026	-	0.304	0.042	-	0.401	0.052	-
	Non-Employment %	4.5%			8.0%			10.6%		
	Guaranteed income (% of lowest income)	7.2%			13.0%			17.0%		
α_i~ U(1,0.4)	Average tax rate	-7.9%	48.8%	46.4%	-2.8%	52.8%	52.0%	2.7%	56.4%	56.3%
	Average m.t. rate	-7.9%	72.8%	36.8%	-2.8%	77.2%	43.0%	2.7%	80.4%	47.7%
	avg. job partiality	28.6%	59.8%	74.4%	27.4%	59.6%	73.8%	26.4%	59.3%	73.2%
	normalized partiality	50.8%	106.4%	132.3%	48.7%	105.9%	131.2%	46.8%	105.4%	130.2%
	H	19.05%	41%	36%	17.29%	40%	36%	15.92%	39%	36%
	avg. η	0.146	0.023	-	0.251	0.037	-	0.326	0.045	-
	Non-Employment %	4.0%			6.9%			9.2%		
	Guaranteed income (% of lowest income)	7.7%			13.5%			17.8%		
α_i ~ U(1,0.3)	Average tax rate	-7.9%	48.8%	46.4%	-2.5%	52.8%	52.0%	2.9%	56.3%	56.3%
	Average m.t. rate	-7.9%	72.8%	36.8%	-2.5%	77.2%	42.9%	2.9%	80.4%	47.7%
	avg. job partiality	33.9%	61.3%	74.4%	32.9%	60.9%	73.7%	32.1%	60.4%	73.2%
	normalized partiality	60.2%	109.0%	132.2%	58.5%	108.2%	131.1%	57.2%	107.5%	130.1%
	H	19.26%	41%	36%	17.71%	40%	36%	16.53%	40%	36%
	avg. η	0.130	0.021	-	0.217	0.033	-	0.277	0.041	-
	Non-Employment %	3.6%			6.2%			8.2%		
	Guaranteed income (% of lowest income)	8.2%			14.2%			18.5%		
α_i ~ U(1,0.2)	Average tax rate	-7.7%	48.8%	46.4%	-2.3%	52.8%	52.0%	2.8%	56.1%	56.3%
	Average m.t. rate	-7.7%	72.8%	36.8%	-2.3%	77.2%	42.9%	2.8%	80.3%	47.7%
	avg. job partiality	39.2%	62.8%	74.3%	38.6%	62.3%	73.7%	38.0%	61.8%	73.1%
	normalized partiality	69.7%	111.7%	132.1%	68.5%	110.8%	131.0%	67.6%	109.9%	130.0%
	H	19.42%	42%	36%	18.04%	41%	36%	17.01%	40%	36%
	avg. η	0.120	0.019	-	0.193	0.030	-	0.241	0.037	-
	Non-Employment %	3.4%			5.7%			7.4%		
	Guaranteed income (% of lowest income)	8.7%			14.9%			19.2%		

Table 4: Optimal EITC with an endogenous intensive-margin elasticity

(Public Good=40,000, lowest α_i for low incomes = 0.9)

Distribution of αi in low income groups	Outcome Reported	v=0.15			v=0.20			v=0.25		
		w1	w2-w6	w7-w11	w1	w2-w6	w7-w11	w1	w2-w6	w7-w11
		0-4500	4500-10000	6700-40000	0-4500	4500-10000	6700-40000	0-4500	4500-10000	6700-40000
αi ~ U(0.9,0.4)	Average tax rate	-1.6%	47.4%	76.9%	0.5%	50.7%	78.6%	2.6%	53.5%	79.9%
	Average m.t. rate	-1.6%	79.9%	95.9%	0.5%	82.9%	96.5%	2.6%	85.2%	97.0%
	avg. job partiality	24.0%	56.8%	70.5%	23.2%	56.5%	69.6%	22.6%	56.2%	68.9%
	normalized partiality	42.6%	100.9%	125.3%	41.3%	100.4%	123.8%	40.2%	99.8%	122.5%
	H	15.77%	41%	36%	14.88%	40%	36%	14.15%	39%	36%
	avg. η	0.557	0.085	-	0.610	0.089	-	0.653	0.092	-
	avg. ε	0.302	0.070	0.020	0.341	0.077	0.022	0.371	0.081	0.023
	Non-Employment %	7.8%			9.4%			10.7%		
	Guaranted income (% of lowest income)	30.7%			33.7%			36.0%		
αi ~ U(0.9,0.3)	Average tax rate	-3.4%	49.3%	77.7%	-1.2%	52.6%	79.4%	1.1%	55.3%	80.7%
	Average m.t. rate	-3.4%	83.1%	95.6%	-1.2%	86.0%	96.3%	1.1%	88.2%	96.8%
	avg. job partiality	30.2%	58.1%	70.0%	29.7%	57.6%	69.1%	29.3%	57.2%	68.3%
	normalized partiality	53.8%	103.2%	124.4%	52.8%	102.4%	122.8%	52.0%	101.7%	121.5%
	H	16.40%	41%	36%	15.69%	40%	36%	15.13%	40%	36%
	avg. η	0.463	0.074	-	0.499	0.077	-	0.525	0.079	-
	avg. ε	0.192	0.059	0.021	0.212	0.064	0.023	0.227	0.068	0.025
	Non-Employment %	7.2%			8.5%			9.5%		
	Guaranted income (% of lowest income)	32.8%			35.7%			37.8%		
αi ~ U(0.9,0.2)	Average tax rate	-6.1%	51.3%	78.4%	-3.9%	54.5%	80.1%	-1.0%	57.0%	81.4%
	Average m.t. rate	-6.1%	86.5%	95.4%	-3.9%	89.3%	96.2%	-1.0%	91.1%	96.7%
	avg. job partiality	36.7%	59.4%	69.5%	36.4%	58.9%	68.6%	36.1%	58.4%	67.8%
	normalized partiality	65.3%	105.6%	123.6%	64.7%	104.6%	121.9%	64.2%	103.8%	120.5%
	H	16.94%	41%	36%	16.37%	40%	36%	15.90%	40%	36%
	avg. η	0.397	0.066	-	0.422	0.069	-	0.439	0.070	-
	avg. ε	0.112	0.050	0.023	0.122	0.054	0.024	0.129	0.057	0.026
	Non-Employment %	6.7%			7.8%			8.6%		
	Guaranted income (% of lowest income)	34.7%			37.5%			39.4%		
αi ~ U(0.9,0.1)	Average tax rate	-10.1%	53.2%	79.1%	-7.4%	56.1%	80.8%	-3.8%	58.3%	82.0%
	Average m.t. rate	-10.1%	90.4%	95.2%	-7.4%	92.7%	96.0%	-3.8%	94.0%	96.5%
	avg. job partiality	43.3%	60.8%	69.0%	43.2%	60.2%	68.1%	43.0%	59.7%	67.3%
	normalized partiality	77.1%	108.1%	122.7%	76.8%	107.1%	121.0%	76.5%	106.2%	119.6%
	H	17.44%	41%	36%	16.98%	40%	36%	16.56%	40%	36%
	avg. η	0.348	0.059	-	0.364	0.062	-	0.377	0.063	-
	avg. ε	0.049	0.044	0.024	0.054	0.046	0.025	0.056	0.049	0.027
	Non-Employment %	6.3%			7.1%			7.9%		
	Guaranted income (% of lowest income)	36.5%			39.0%			40.8%		

reduction of the intensive-margin second-group elasticity increases the optimal EITC. The intuition is the following: as the demand for labor of the second group becomes more rigid, plausibility of an EITC.[15] By looking at the different scenarios of Table 4 it is possible to see that the intensive-margin elasticity declines as the ranges for α increase: i.e., the average intensive-margin demand for labor of the first and second groups becomes more rigid (ε_1 and ε_2 are low).[16] By looking at equation 8, it is clear that it is optimal for the social planner to give an EITC to the first group, which enhances the probability that this group participates at the labor market.

4.3.3 Constant labor supply elasticity

The simulations are based on equation D.2 (Appendix D). Interestingly, as shown in tables 5 to 8, this case derived on an increasing EITC as a reaction to learning, but the mechanism explaining the result is different. While in the logarithmic case the increase in EITC was related to the elasticity of the second group, in this case it is related to the increase in the size of the first group (h_1), that interacts in a particular way with ε_1 and η_1. Since the labor supply in this case is very sensitive, the reduction of labor aversion implies that a higher portion of individuals enter the labor market, in an increasing pace and from a low level. Thus, in this case the result obtained by

[15] In our simulations this case is characterized by low values of the intensive-margin elasticities of high income individuals, which implies a high level of tax revenues – allowing for a higher allocation for both the public good and redistribution.

[16] A reduction in labor aversion implies that the average working poor's α decreases, causing a decline in his/her intensive-margin elasticity. At the same time working poor individuals participate more at the labor market. This process implies that leisure-loving individuals account for a smaller share of those who work, and have a smaller effect on the average working poor's intensive-margin elasticity.

Table 5

(Public Good=3,650, ε_{low}=0.05, $\varepsilon_{\text{high}}$=0.25, lowest α_i for low incomes = 0.9)

Distribution of αi in low income groups	Outcome Reported	v=0.15			v=0.30			v=0.45		
		w1	w2-w6	w7-w11	w1	w2-w6	w7-w11	w1	w2-w6	w7-w11
		2000-4300	4300-10000	10000-40000	2000-4300	4300-10000	10000-40000	2000-4300	4300-10000	10000-40000
αi ~ U(0.9,0.4)	Average tax rate	-2.7%	23.8%	45.5%	-4.9%	31.6%	57.5%	-5.9%	37.0%	63.7%
	Average m.t. rate	-2.7%	54.1%	51.0%	-4.9%	69.8%	65.5%	-5.9%	78.8%	72.3%
	avg. job partiality	48.3%	88.5%	100.0%	50.4%	87.1%	100.0%	51.3%	85.9%	100.0%
	normalized partiality	85.8%	157.4%	177.8%	89.7%	154.8%	177.8%	91.3%	152.7%	177.8%
	h	5.49%	39%	38%	5.89%	31%	36%	6.08%	26%	33%
	avg. η	3.689	0.882	-	3.689	0.926	-	3.689	0.945	-
	avg. ε	0.016	0.181	0.250	0.016	0.177	0.250	0.016	0.175	0.250
	Non-Employment %	17.4%			26.3%			34.7%		
	Guaranted income (% of lowest income)	31.6%			47.2%			48.3%		
αi ~ U(0.9,0.3)	Average tax rate	-4.5%	24.0%	45.7%	-7.8%	31.9%	57.8%	-8.9%	36.9%	64.0%
	Average m.t. rate	-4.5%	55.7%	51.0%	-7.8%	72.3%	65.5%	-8.9%	81.2%	72.3%
	avg. job partiality	67.3%	90.5%	100.0%	68.1%	89.4%	100.0%	68.4%	88.5%	100.0%
	normalized partiality	119.7%	160.9%	177.8%	121.1%	158.9%	177.8%	121.6%	157.4%	177.8%
	h	7.41%	38%	38%	7.92%	31%	36%	8.09%	27%	32%
	avg. η	2.284	0.784	-	2.284	0.831	-	2.284	0.857	-
	avg. ε	0.022	0.180	0.250	0.022	0.174	0.250	0.022	0.171	0.250
	Non-Employment %	15.6%			24.6%			32.7%		
	Guaranted income (% of lowest income)	32.2%			47.3%			48.2%		
αi ~ U(0.9,0.2)	Average tax rate	-6.1%	24.3%	45.9%	-10.1%	32.1%	58.0%	-10.8%	36.7%	64.1%
	Average m.t. rate	-6.1%	57.2%	50.9%	-10.1%	74.3%	65.5%	-10.8%	82.7%	72.3%
	avg. job partiality	75.8%	91.9%	100.0%	76.1%	91.0%	100.0%	76.1%	90.4%	100.0%
	normalized partiality	134.8%	163.4%	177.8%	135.2%	161.8%	177.8%	135.3%	160.7%	177.8%
	h	8.76%	38%	38%	9.28%	31%	36%	9.37%	27%	32%
	avg. η	1.641	0.710	-	1.641	0.755	-	1.641	0.783	-
	avg. ε	0.026	0.179	0.250	0.026	0.172	0.250	0.026	0.168	0.250
	Non-Employment %	14.5%			23.5%			31.3%		
	Guaranted income (% of lowest income)	32.6%			47.4%			48.0%		
αi ~ U(0.9,0.1)	Average tax rate	-7.7%	24.5%	46.0%	-12.1%	32.1%	58.1%	-12.3%	36.4%	64.2%
	Average m.t. rate	-7.7%	58.5%	50.9%	-12.1%	75.7%	65.4%	-12.3%	83.7%	72.3%
	avg. job partiality	80.7%	92.9%	100.0%	80.6%	92.2%	100.0%	80.6%	91.7%	100.0%
	normalized partiality	143.4%	165.2%	177.8%	143.3%	163.9%	177.8%	143.3%	163.1%	177.8%
	h	9.77%	38%	38%	10.27%	31%	36%	10.30%	27%	32%
	avg. η	1.254	0.660	-	1.254	0.703	-	1.254	0.730	-
	avg. ε	0.029	0.178	0.250	0.029	0.171	0.250	0.029	0.165	0.250
	Non-Employment %	13.6%			22.4%			30.0%		
	Guaranted income (% of lowest income)	32.8%			47.3%			47.9%		

Table 6

(Public Good=3,650, ε_{low}=0.05, $\varepsilon_{\text{high}}$=0.25, lowest α_i for low incomes = 1)

Distribution of αi in low income groups	Outcome Reported	v=0.15			v=0.30			v=0.45		
		w1	w2-w6	w7-w11	w1	w2-w6	w7-w11	w1	w2-w6	w7-w11
		2000-4300	4300-10000	10000-40000	2000-4300	4300-10000	10000-40000	2000-4300	4300-10000	10000-40000
αi ~ U(0.9,0.4)	Average tax rate	-0.6%	26.5%	46.4%	-0.7%	35.9%	58.7%	0.0%	42.6%	65.2%
	Average m.t. rate	-0.6%	55.1%	51.4%	-0.7%	70.6%	65.9%	0.0%	79.5%	72.6%
	avg. job partiality	4.9%	87.3%	100.0%	5.0%	85.1%	100.0%	4.6%	82.9%	100.0%
	normalized partiality	8.8%	155.2%	177.8%	8.9%	151.3%	177.8%	8.1%	147.3%	177.8%
	h	2.03%	34%	38%	2.05%	26%	36%	1.92%	20%	31%
	avg. η	9.581	0.926	-	9.581	0.946	-	9.581	0.927	-
	avg. ε	0.006	0.190	0.250	0.006	0.189	0.250	0.006	0.192	0.250
	Non-Employment %	25.3%			36.4%			46.5%		
	Guaranted income (% of lowest income)	33.4%			47.3%			46.3%		
αi ~ U(0.9,0.3)	Average tax rate	-2.4%	26.4%	46.5%	-3.8%	35.7%	59.0%	-3.2%	41.8%	65.5%
	Average m.t. rate	-2.4%	56.7%	51.3%	-3.8%	73.2%	65.8%	-3.2%	82.1%	72.6%
	avg. job partiality	48.0%	89.7%	100.0%	49.4%	88.1%	100.0%	48.8%	86.6%	100.0%
	normalized partiality	85.3%	159.4%	177.8%	87.8%	156.6%	177.8%	86.7%	153.9%	177.8%
	h	4.53%	35%	38%	4.75%	27%	35%	4.65%	21%	31%
	avg. η	3.598	0.823	-	3.598	0.862	-	3.598	0.878	-
	avg. ε	0.014	0.187	0.250	0.014	0.183	0.250	0.014	0.182	0.250
	Non-Employment %	22.4%			33.4%			43.2%		
	Guaranted income (% of lowest income)	33.9%			47.7%			46.4%		
αi ~ U(0.9,0.2)	Average tax rate	-4.0%	26.6%	46.7%	-6.1%	35.6%	59.2%	-5.0%	41.3%	65.6%
	Average m.t. rate	-4.0%	58.1%	51.2%	-6.1%	75.2%	65.7%	-5.0%	83.7%	72.5%
	avg. job partiality	67.2%	91.3%	100.0%	67.7%	90.1%	100.0%	67.5%	89.1%	100.0%
	normalized partiality	119.5%	162.3%	177.8%	120.4%	160.2%	177.8%	119.9%	158.3%	177.8%
	h	6.30%	35%	38%	6.56%	27%	35%	6.42%	22%	31%
	avg. η	2.265	0.743	-	2.265	0.789	-	2.265	0.816	-
	avg. ε	0.019	0.185	0.250	0.019	0.179	0.250	0.019	0.175	0.250
	Non-Employment %	20.4%			31.3%			40.8%		
	Guaranted income (% of lowest income)	34.4%			47.9%			46.5%		
αi ~ U(0.9,0.1)	Average tax rate	-5.7%	26.6%	46.8%	-8.1%	35.4%	59.3%	-6.4%	40.7%	65.6%
	Average m.t. rate	-5.7%	59.4%	51.2%	-8.1%	76.7%	65.7%	-6.4%	84.5%	72.5%
	avg. job partiality	75.8%	92.5%	100.0%	76.0%	91.5%	100.0%	75.9%	90.8%	100.0%
	normalized partiality	134.8%	164.5%	177.8%	135.0%	162.7%	177.8%	134.9%	161.4%	177.8%
	h	7.62%	35%	38%	7.89%	27%	35%	7.70%	23%	31%
	avg. η	1.600	0.688	-	1.600	0.736	-	1.600	0.767	-
	avg. ε	0.023	0.183	0.250	0.023	0.175	0.250	0.023	0.170	0.250
	Non-Employment %	18.9%			29.6%			38.7%		
	Guaranted income (% of lowest income)	34.7%			48.0%			46.7%		

Table 7

(Public good=3,650, ε_{low}=0.05, $\varepsilon_{\text{high}}$=0.5, lowest α_i for low incomes = 0.9**)**

Distribution of αi in low income groups	Outcome Reported	v=0.15			v=0.30			v=0.45		
		w1	w2-w6	w7-w11	w1	w2-w6	w7-w11	w1	w2-w6	w7-w11
		2000-4300	4300-10000	10000-40000	2000-4300	4300-10000	10000-40000	2000-4300	4300-10000	10000-40000
αi ~ U(0.9,0.4)	Average tax rate	-2.7%	19.2%	33.4%	-4.9%	28.7%	46.5%	-5.9%	34.7%	53.8%
	Average m.t. rate	-2.7%	42.6%	34.7%	-4.9%	60.6%	49.3%	-5.9%	71.4%	57.2%
	avg. job partiality	48.3%	89.3%	100.0%	50.4%	88.3%	100.0%	51.3%	86.8%	100.0%
	normalized partiality	85.8%	158.8%	177.8%	89.7%	157.0%	177.8%	91.3%	154.4%	177.8%
	h	5.49%	42%	38%	5.89%	35%	38%	6.08%	28%	37%
	avg. η	3.689	0.600	-	3.689	0.621	-	3.689	0.657	-
	avg. ε	0.016	0.356	0.500	0.016	0.352	0.500	0.016	0.343	0.500
	Non-Employment %	14.5%			20.9%			28.2%		
	Guaranted income (% of lowest income)	1.4%			18.6%			23.5%		
αi ~ U(0.9,0.3)	Average tax rate	-4.5%	19.6%	33.6%	-7.8%	29.1%	46.7%	-8.9%	34.7%	54.1%
	Average m.t. rate	-4.5%	44.2%	34.7%	-7.8%	63.1%	49.2%	-8.9%	73.8%	57.2%
	avg. job partiality	67.3%	91.2%	100.0%	68.1%	90.4%	100.0%	68.4%	89.3%	100.0%
	normalized partiality	119.7%	162.1%	177.8%	121.1%	160.7%	177.8%	121.6%	158.7%	177.8%
	h	7.41%	41%	38%	7.92%	35%	38%	8.09%	29%	37%
	avg. η	2.284	0.511	-	2.284	0.541	-	2.284	0.585	-
	avg. ε	0.022	0.355	0.500	0.022	0.346	0.500	0.022	0.333	0.500
	Non-Employment %	12.6%			19.1%			26.2%		
	Guaranted income (% of lowest income)	2.1%			19.0%			23.7%		
αi ~ U(0.9,0.2)	Average tax rate	-6.1%	20.0%	33.8%	-10.1%	29.4%	46.9%	-10.8%	34.7%	54.2%
	Average m.t. rate	-6.1%	45.7%	34.7%	-10.1%	65.1%	49.2%	-10.8%	75.3%	57.1%
	avg. job partiality	75.8%	92.5%	100.0%	76.1%	91.8%	100.0%	76.1%	91.0%	100.0%
	normalized partiality	134.8%	164.5%	177.8%	135.2%	163.2%	177.8%	135.3%	161.7%	177.8%
	h	8.76%	41%	38%	9.28%	34%	38%	9.37%	29%	37%
	avg. η	1.641	0.442	-	1.641	0.478	-	1.641	0.523	-
	avg. ε	0.026	0.353	0.500	0.026	0.341	0.500	0.026	0.326	0.500
	Non-Employment %	11.4%			17.9%			24.7%		
	Guaranted income (% of lowest income)	2.6%			19.4%			23.8%		
αi ~ U(0.9,0.1)	Average tax rate	-7.7%	20.3%	33.9%	-12.1%	29.5%	47.0%	-12.3%	34.5%	54.2%
	Average m.t. rate	-7.7%	47.0%	34.6%	-12.1%	66.5%	49.2%	-12.3%	76.2%	57.1%
	avg. job partiality	80.7%	93.5%	100.0%	80.6%	92.9%	100.0%	80.6%	92.2%	100.0%
	normalized partiality	143.4%	166.2%	177.8%	143.3%	165.2%	177.8%	143.3%	164.0%	177.8%
	h	9.77%	41%	38%	10.27%	35%	38%	10.30%	29%	37%
	avg. η	1.254	0.397	-	1.254	0.435	-	1.254	0.478	-
	avg. ε	0.029	0.352	0.500	0.029	0.337	0.500	0.029	0.321	0.500
	Non-Employment %	10.4%			16.8%			23.4%		
	Guaranted income (% of lowest income)	2.9%			19.4%			23.8%		

Table 8 (Public Good=3,650, ε_{low}=0.05, $\varepsilon_{\text{high}}$=0. 5, lowest α_i for low incomes = 1)

Distribution of αi in low income groups	Outcome Reported	v=0.15			v=0.30			v=0.45		
		w1	w2-w6	w7-w11	w1	w2-w6	w7-w11	w1	w2-w6	w7-w11
		2000-4300	4300-10000	10000-40000	2000-4300	4300-10000	10000-40000	2000-4300	4300-10000	10000-40000
αi ~ U(0.9,0.4)	Average tax rate	-0.6%	21.7%	34.4%	-0.7%	32.6%	47.7%	0.0%	39.9%	55.4%
	Average m.t. rate	-0.6%	43.7%	35.1%	-0.7%	61.7%	49.7%	0.0%	72.3%	57.6%
	avg. job partiality	4.9%	88.4%	100.0%	5.0%	86.6%	100.0%	4.6%	84.0%	100.0%
	normalized partiality	8.8%	157.2%	177.8%	8.9%	153.9%	177.8%	8.1%	149.3%	177.8%
	H	2.03%	37%	38%	2.06%	29%	38%	1.92%	22%	36%
	avg. η	9.581	0.610	-	9.581	0.610	-	9.581	0.608	-
	avg. ε	0.006	0.381	0.500	0.006	0.381	0.500	0.006	0.381	0.500
	Non-Employment %	22.1%			30.6%			40.1%		
	Guaranted income (% of lowest income)	3.3%			19.9%			23.0%		
αi ~ U(0.9,0.3)	Average tax rate	-2.4%	21.9%	34.5%	-3.8%	32.6%	48.0%	-3.2%	39.4%	55.6%
	Average m.t. rate	-2.4%	45.2%	35.0%	-3.8%	64.2%	49.6%	-3.2%	74.9%	57.5%
	avg. job partiality	48.0%	90.6%	100.0%	49.4%	89.2%	100.0%	48.8%	87.4%	100.0%
	normalized partiality	85.3%	161.1%	177.8%	87.9%	158.6%	177.8%	86.7%	155.4%	177.8%
	H	4.53%	38%	38%	4.75%	29%	38%	4.65%	23%	36%
	avg. η	3.598	0.521	-	3.598	0.550	-	3.598	0.584	-
	avg. ε	0.014	0.374	0.500	0.014	0.367	0.500	0.014	0.359	0.500
	Non-Employment %	19.0%			27.5%			36.8%		
	Guaranted income (% of lowest income)	4.0%			20.6%			23.4%		
αi ~ U(0.9,0.2)	Average tax rate	-4.0%	22.1%	34.6%	-6.1%	32.7%	48.2%	-5.0%	39.1%	55.8%
	Average m.t. rate	-4.0%	46.7%	34.9%	-6.1%	66.2%	49.5%	-5.0%	76.4%	57.4%
	avg. job partiality	67.2%	92.1%	100.0%	67.7%	91.0%	100.0%	67.5%	89.7%	100.0%
	normalized partiality	119.5%	163.7%	177.8%	120.4%	161.8%	177.8%	119.9%	159.4%	177.8%
	H	6.29%	38%	38%	6.57%	30%	38%	6.42%	23%	36%
	avg. η	2.265	0.452	-	2.265	0.494	-	2.265	0.542	-
	avg. ε	0.019	0.369	0.500	0.019	0.357	0.500	0.019	0.343	0.500
	Non-Employment %	16.9%			25.4%			34.4%		
	Guaranted income (% of lowest income)	4.6%			21.0%			23.7%		
αi ~ U(0.9,0.1)	Average tax rate	-5.6%	22.3%	34.7%	-8.1%	32.6%	48.2%	-6.4%	38.6%	55.7%
	Average m.t. rate	-5.6%	47.9%	34.9%	-8.1%	67.6%	49.4%	-6.4%	77.2%	57.3%
	avg. job partiality	75.8%	93.2%	100.0%	76.0%	92.3%	100.0%	75.9%	91.3%	100.0%
	normalized partiality	134.8%	165.7%	177.8%	135.0%	164.1%	177.8%	134.9%	162.3%	177.8%
	H	7.62%	39%	38%	7.89%	30%	38%	7.70%	24%	36%
	avg. η	1.600	0.407	-	1.600	0.454	-	1.600	0.506	-
	avg. ε	0.023	0.365	0.500	0.023	0.349	0.500	0.023	0.332	0.500
	Non-Employment %	15.3%			23.6%			32.3%		
	Guaranted income (% of lowest income)	4.9%			21.1%			24.0%		

Saez (2002) is reversed: an increase in extensive margin elasticity derives in a reduction of the optimal EITC, due to the low level of h.

In the long-run, given that the reduction of α implies that h for the working poor goes up, it is optimal to increase the EITC and thus in this case the optimal long-run policy is characterized by increasing EITC.

5. Summary and conclusions

This paper studies the optimal EITC schedules when the government achieves its long-run policy by reducing the labor aversion of the working poor with the goal of allowing a persistent participation at the labor market. First we show that when the government implements policies aimed at keeping the working poor at the labor market, it achieves a reduction of his labor aversion. Then, we show that a decrease in labor aversion by the working poor implies a transition from an asymmetric density of tastes toward leisure, to a uniform density, in which most individuals tend to have similar tastes concerning labor aversion. Finally, we calculate the optimal EITC transfers that are related to the labor aversion of individuals through their impact on the intensive and extensive margin elasticities of the working poor, as shown by Saez (2002). The main difference between Saez's model and ours is that the elasticities in our case are related to the working poor's participation decision, which in turn is related to his labor aversion tastes and to the level of guaranteed income.

In order to understand the implications of the reduction of labor aversion in the long-run we performed simulations, based on different values of five parameters: public good budget requirements, the intensive-margin elasticities, the starting working poor's labor aversion parameter, working poor's range of labor aversion parameters and government's inequality aversion. In all cases we use endogenous extensive-margin elasticities, coming from our model of heterogenous tastes for leisure.

The simulations show that when the inequality aversion is low, it is optimal to impose an EITC for the working poor. This result is consistent with Saez (2002) and is resilient to different amounts of resources spent on the public good, and for different values of the intensive-margin elasticity.

Our simulations also show, that when using an exogenously given intensive-margin elasticity, as the labor aversion goes down (and consequently the endogenous extensive margin elasticity also declines), it is optimal to reduce the EITC for the working poor. This result is similar to the result obtained in Saez's simulations given an exogenous decline in the extensive margin elasticity. However, we find that when the extensive margin elasticity is endogenous this effect becomes much weaker, and in some cases is even reversed, due to the fact that in the endogenous case a high extensive elasticity is only obtained when low income individuals are very labor averse, and thus the initial share of unemployed individuals is larger relative to the working poor - which makes the EITC a less attractive tool for the policy maker. This result is a novelty because it takes in too account the endogenous nature of the extensive margin elasticity – introducing an offsetting effect which (relative to Saez's results) significantly reduces the magnitude of the effect of changes in $\boldsymbol{\eta}$ on the size of the optimal EITC. It is interesting to note that there are special cases in which the opposite result holds: the optimal EITC transfer goes up as long as labor aversion goes down. This result was obtained for: i) an endogenous intensive-margin elasticity under a logarithmic utility; the intuition of this result is that a reduction in labor aversion implies a reduction of the intensive-margin elasticity, which makes attractive for the policy maker to keep the working poor at the labor market, by giving him an EITC transfer; and ii) a constant labor supply elasticity; the intuition in this case is different: it derives from the fact that at the initial stage there is a thin group of working poor individuals that enter the labor market as labor aversion goes down, increasing policy maker's incentive for keeping them at the labor market through a higher EITC.

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Appendix A – Optimal EITC

In this appendix we obtain the optimal EITC shown in equation 8. The optimal taxes according to Saez (2002) are:

A.1) $\frac{T_i - T_{i-1}}{C_i - C_{i-1}} = \frac{1}{\zeta_i h_i} \cdot \sum_{j=i}^{I} h_j \left[1 - g_j - \eta_j \frac{T_j - T_0}{C_j - C_0}\right]$

We assume now that $\eta_i = 0 \ \forall \ i > 2$. Consequently, we obtain the following formula for the average tax rate, represented by t:

$$\frac{T_i - T_{i-1}}{C_i - C_{i-1}} = \frac{1}{\zeta_i h_i} \cdot \sum_{j=i}^{I} h_j \left[1 - g_j\right]$$

$$\frac{t_i w_i + T_0 - t_{i-1} w_{i-1} - T_0}{(1 - t_i) w_i + T_0 - (1 - t_{i-1}) w_{i-1} - T_0} = \frac{1}{\zeta_i h_i} \cdot \sum_{j=i}^{I} h_j \left[1 - g_j\right]$$

$$\frac{t_i w_i - t_{i-1} w_{i-1}}{(1 - t_i) w_i - (1 - t_{i-1}) w_{i-1}} = \frac{1}{\zeta_i h_i} \cdot \sum_{j=i}^{I} h_j \left[1 - g_j\right]$$

$$\frac{t_i w_i - t_{i-1} w_{i-1}}{w_i - t_i w_i - w_{i-1} + t_{i-1} w_{i-1}} = \frac{1}{\zeta_i h_i} \cdot \sum_{j=i}^{I} h_j \left[1 - g_j\right]$$

$$\frac{w_i - t_i w_i - w_{i-1} + t_{i-1} w_{i-1}}{t_i w_i - t_{i-1} w_{i-1}} = \frac{\zeta_i h_i}{\sum_{j=i}^{I} h_j \left[1 - g_j\right]}$$

$$\frac{w_i - w_{i-1}}{t_i w_i - t_{i-1} w_{i-1}} = \frac{\zeta_i h_i}{\sum_{j=i}^{I} h_j \left[1 - g_j\right]} + 1$$

$$\frac{w_i - w_{i-1}}{t_i w_i - t_{i-1} w_{i-1}} = \frac{\zeta_i h_i + \sum_{j=i}^{I} h_j \left[1 - g_j\right]}{\sum_{j=i}^{I} h_j \left[1 - g_j\right]}$$

$$\frac{t_i w_i - t_{i-1} w_{i-1}}{w_i - w_{i-1}} = \frac{\sum_{j=i}^{I} h_j \left[1 - g_j\right]}{\zeta_i h_i + \sum_{j=i}^{I} h_j \left[1 - g_j\right]}$$

$$t_i w_i - t_{i-1} w_{i-1} = (w_i - w_{i-1}) \cdot \left[1 - \frac{\zeta_i h_i}{\zeta_i h_i + \sum_{j=i}^{I} h_j \left[1 - g_j\right]}\right]$$

$$\text{A.2)} \quad t_i = t_{i-1}\frac{w_{i-1}}{w_i} + \frac{(w_i - w_{i-1})}{w_i} \cdot \left[1 - \frac{\zeta_i h_i}{\zeta_i h_i + \sum_{j=i}^{I} h_j[1-g_j]}\right]$$

Our assumption of an endogenous decision about participation at the labor market implies that $\eta_i > 0 \ \forall \ i < 3$. Thus, we obtain the following formulae.

For $i = 1$:

$$\frac{T_1 - T_0}{C_1 - C_0} = \frac{1}{h_1\zeta_1} \cdot \left[(g_0 - 1)h_0 - h_1\eta_1 \cdot \frac{T_1 - T_0}{C_1 - C_0} - h_2\eta_2 \cdot \frac{T_2 - T_0}{C_2 - C_0}\right]$$

$$\frac{t_1}{1 - t_1} = \frac{1}{h_1\zeta_1} \cdot \left[(g_0 - 1)h_0 - h_1\eta_1 \cdot \frac{t_1}{1 - t_1} - h_2\eta_2 \cdot \frac{t_2}{1 - t_2}\right]$$

$$h_1(\zeta_1 + \eta_1)\frac{t_1}{1 - t_1} = (g_0 - 1)h_0 - h_2\eta_2 \cdot \frac{t_2}{1 - t_2}$$

$$h_2\eta_2 \cdot \frac{t_2}{1 - t_2} = (g_0 - 1)h_0 - h_1(\zeta_1 + \eta_1)\frac{t_1}{1 - t_1}$$

$$\frac{t_2}{1 - t_2} = \frac{(g_0 - 1)h_0 - h_1(\zeta_1 + \eta_1)\frac{t_1}{1 - t_1}}{h_2\eta_2}$$

$$\frac{1}{1 - t_2} = \frac{h_2\eta_2 + (g_0 - 1)h_0 - h_1(\zeta_1 + \eta_1)\frac{t_1}{1 - t_1}}{h_2\eta_2}$$

$$1 - t_2 = \frac{h_2\eta_2}{h_2\eta_2 + (g_0 - 1)h_0 - h_1(\zeta_1 + \eta_1)\frac{t_1}{1 - t_1}}$$

$$\text{A.3)} \; t_2 = 1 - \frac{h_2\eta_2}{h_2\eta_2 + (g_0 - 1)h_0 - h_1(\zeta_1 + \eta_1)\frac{t_1}{1 - t_1}}$$

For $i = 2$:

$$\frac{T_2 - T_1}{C_2 - C_1} = \frac{1}{h_2\zeta_2} \cdot \left[(g_0 - 1)h_0 + (g_1 - 1)h_1 - h_2\eta_2 \cdot \frac{T_2 - T_0}{C_2 - C_0}\right]$$

$$\frac{t_2 w_2 - t_1 w_1}{(1 - t_2)w_2 - (1 - t_1)w_1} = \frac{\left[(g_0 - 1)h_0 + (g_1 - 1)h_1 - h_2\eta_2 \cdot \frac{t_2}{1 - t_2}\right]}{h_2\zeta_2}$$

$$\frac{t_2 w_2 - t_1 w_1}{w_2 - t_2 w_2 - w_1 + t_1 w_1} = \frac{\left[(g_0 - 1)h_0 + (g_1 - 1)h_1 - h_2\eta_2 \cdot \frac{t_2}{1 - t_2}\right]}{h_2\zeta_2}$$

$$\frac{w_2 - t_2 w_2 - w_1 + t_1 w_1}{t_2 w_2 - t_1 w_1} = \frac{h_2\zeta_2}{\left[(g_0 - 1)h_0 + (g_1 - 1)h_1 - h_2\eta_2 \cdot \frac{t_2}{1 - t_2}\right]}$$

$$\frac{w_2 - w_1}{t_2 w_2 - t_1 w_1} = \frac{h_2\zeta_2 + (g_0 - 1)h_0 + (g_1 - 1)h_1 - h_2\eta_2 \cdot \frac{t_2}{1 - t_2}}{(g_0 - 1)h_0 + (g_1 - 1)h_1 - h_2\eta_2 \cdot \frac{t_2}{1 - t_2}}$$

$$\frac{t_2 w_2 - t_1 w_1}{w_2 - w_1} = \frac{(g_0 - 1)h_0 + (g_1 - 1)h_1 - h_2\eta_2 \cdot \frac{t_2}{1 - t_2}}{h_2\zeta_2 + (g_0 - 1)h_0 + (g_1 - 1)h_1 - h_2\eta_2 \cdot \frac{t_2}{1 - t_2}}$$

$$t_1 w_1 = t_2 w_2 - (w_2 - w_1)\frac{(g_0 - 1)h_0 + (g_1 - 1)h_1 - h_2\eta_2 \cdot \frac{t_2}{1 - t_2}}{h_2\zeta_2 + (g_0 - 1)h_0 + (g_1 - 1)h_1 - h_2\eta_2 \cdot \frac{t_2}{1 - t_2}}$$

A.4) $t_1 = t_2 \frac{w_2}{w_1} - \frac{w_2 - w_1}{w_1} \cdot \left[1 - \frac{h_2\zeta_2}{h_2\zeta_2 + (g_0 - 1)h_0 + (g_1 - 1)h_1 - h_2\eta_2 \cdot \frac{t_2}{1 - t_2}}\right]$

Appendix B: Sensitivity Analysis

Table B.1: Public Good=25,050, ε_{low}=0, $\varepsilon_{\text{high}}$=0.25, lowest α_i for low incomes = 0.9

Distribution of α_i in low income groups	Outcome Reported	v=0.15			v=0.20			v=0.25		
		w1	w2-w6	w7-w11	w1	w2-w6	w7-w11	w1	w2-w6	w7-w11
		0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000
α_i ~ U(0.9,0.4)	Average tax rate	-17.9%	50.3%	57.0%	-12.3%	54.1%	62.1%	-6.8%	57.3%	65.9%
	Average m.t. rate	-17.9%	82.7%	53.3%	-12.3%	86.2%	59.6%	-6.8%	88.5%	64.2%
	avg. job partiality	24.5%	56.9%	71.9%	22.9%	56.3%	70.6%	21.5%	55.6%	69.5%
	normalized partiality	43.5%	101.2%	127.8%	40.6%	100.0%	125.6%	38.2%	98.8%	123.6%
	H	16.46%	40%	36%	14.44%	38%	36%	12.89%	37%	36%
	avg. η	0.588	0.084	-	0.729	0.093	-	0.837	0.097	-
	Non-Employment %	8.3%			11.7%			14.2%		
	Guaranteed income (% of lowest income)	32.5%			40.1%			45.6%		
α_i ~ U(0.9,0.3)	Average tax rate	-17.8%	50.1%	57.0%	-12.1%	53.9%	62.1%	-6.5%	57.1%	65.9%
	Average m.t. rate	-17.8%	82.7%	53.2%	-12.1%	86.2%	59.6%	-6.5%	88.5%	64.1%
	avg. job partiality	30.8%	58.3%	71.8%	29.6%	57.4%	70.6%	28.5%	56.5%	69.4%
	normalized partiality	54.8%	103.6%	127.7%	52.6%	102.0%	125.5%	50.6%	100.4%	123.4%
	H	17.21%	40%	36%	15.50%	39%	36%	14.19%	38%	36%
	avg. η	0.464	0.072	-	0.559	0.081	-	0.627	0.085	-
	Non-Employment %	7.0%			9.9%			12.1%		
	Guaranteed income (% of lowest income)	32.8%			40.6%			46.3%		
α_i ~ U(0.9,0.2)	Average tax rate	-17.5%	49.9%	57.0%	-11.9%	53.6%	62.1%	-6.3%	56.8%	65.8%
	Average m.t. rate	-17.5%	82.7%	53.2%	-11.9%	86.1%	59.5%	-6.3%	88.4%	64.1%
	avg. job partiality	37.2%	59.9%	71.8%	36.3%	58.8%	70.5%	35.6%	57.7%	69.3%
	normalized partiality	66.1%	106.4%	127.6%	64.6%	104.5%	125.4%	63.3%	102.7%	123.3%
	H	17.74%	40%	36%	16.27%	39%	36%	15.12%	39%	36%
	avg. η	0.384	0.062	-	0.454	0.071	-	0.503	0.075	-
	Non-Employment %	6.1%			8.6%			10.5%		
	Guaranteed income (% of lowest income)	33.3%			41.1%			46.9%		
α_i ~ U(0.9,0.1)	Average tax rate	-17.8%	49.6%	56.9%	-11.8%	53.4%	62.1%	-6.0%	56.6%	65.8%
	Average m.t. rate	-17.8%	82.6%	53.2%	-11.8%	86.1%	59.5%	-6.0%	88.4%	64.1%
	avg. job partiality	43.6%	61.6%	71.8%	43.1%	60.4%	70.5%	42.8%	59.3%	69.3%
	normalized partiality	77.5%	109.5%	127.6%	76.7%	107.4%	125.3%	76.0%	105.4%	123.1%
	H	18.18%	41%	36%	16.84%	40%	36%	15.81%	39%	36%
	avg. η	0.326	0.056	-	0.384	0.064	-	0.422	0.068	-
	Non-Employment %	5.4%			7.6%			9.4%		
	Guaranteed income (% of lowest income)	33.5%			41.6%			47.6%		

Table B.2: Public Good=20,000, ε_{low}=0, $\varepsilon_{\text{high}}$=0.25, lowest α_i for low incomes = 0.9

Distribution of α_i in low income groups	Outcome Reported	v=0.15			v=0.20			v=0.25		
		w1	w2-w6	w7-w11	w1	w2-w6	w7-w11	w1	w2-w6	w7-w11
		0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000
αi ~ U(0.9,0.4)	Average tax rate	-15.4%	51.6%	57.6%	-9.6%	55.5%	62.7%	-3.8%	58.7%	66.5%
	Average m.t. rate	-15.4%	83.1%	53.6%	-9.6%	86.5%	59.9%	-3.8%	88.8%	64.4%
	avg. job partiality	21.3%	55.9%	70.0%	19.5%	54.9%	68.6%	17.8%	54.0%	67.2%
	normalized partiality	37.8%	99.3%	124.5%	34.6%	97.6%	121.9%	31.7%	95.9%	119.5%
	h	12.71%	37%	36%	10.93%	36%	36%	9.50%	35%	36%
	avg. η	0.934	0.105	-	1.094	0.107	-	1.228	0.104	-
	Non-Employment %	14.5%			17.5%			19.9%		
	Guaranteed income (% of lowest income)	50.3%			57.7%			63.2%		
α_i ~ U(0.9,0.3)	Average tax rate	-15.4%	51.3%	57.5%	-9.3%	55.2%	62.7%	-3.6%	58.4%	66.4%
	Average m.t. rate	-15.4%	83.0%	53.5%	-9.3%	86.4%	59.8%	-3.6%	88.7%	64.3%
	avg. job partiality	28.4%	56.7%	70.0%	27.0%	55.5%	68.5%	25.8%	54.3%	67.1%
	normalized partiality	50.5%	100.9%	124.5%	48.0%	98.6%	121.8%	45.8%	96.5%	119.4%
	h	14.12%	38%	36%	12.59%	37%	36%	11.39%	36%	36%
	avg. η	0.681	0.092	-	0.775	0.095	-	0.844	0.096	-
	Non-Employment %	12.2%			14.7%			16.7%		
	Guaranteed income (% of lowest income)	50.6%			58.2%			63.8%		
α_i~ U(0.9,0.2)	Average tax rate	-15.4%	51.0%	57.5%	-9.2%	54.9%	62.6%	-3.2%	58.2%	66.4%
	Average m.t. rate	-15.4%	82.9%	53.4%	-9.2%	86.3%	59.7%	-3.2%	88.6%	64.3%
	avg. job partiality	35.6%	58.1%	70.0%	34.6%	56.6%	68.5%	33.7%	55.3%	67.1%
	normalized partiality	63.3%	103.3%	124.4%	61.5%	100.7%	121.7%	60.0%	98.3%	119.2%
	h	15.11%	39%	36%	13.78%	38%	36%	12.72%	37%	36%
	avg. η	0.538	0.081	-	0.599	0.085	-	0.642	0.086	-
	Non-Employment %	10.5%			12.7%			14.5%		
	Guaranteed income (% of lowest income)	51.0%			58.8%			64.5%		
α_i ~ U(0.9,0.1)	Average tax rate	-15.2%	50.8%	57.4%	-9.0%	54.7%	62.6%	-3.0%	57.9%	66.4%
	Average m.t. rate	-15.2%	82.9%	53.4%	-9.0%	86.3%	59.7%	-3.0%	88.5%	64.2%
	avg. job partiality	42.8%	59.7%	69.9%	42.3%	58.2%	68.4%	41.8%	56.7%	67.0%
	normalized partiality	76.0%	106.1%	124.3%	75.2%	103.4%	121.6%	74.4%	100.9%	119.1%
	h	15.83%	39%	36%	14.66%	38%	36%	13.73%	38%	36%
	avg. η	0.444	0.072	-	0.490	0.076	-	0.519	0.078	-
	Non-Employment %	9.3%			11.3%			12.8%		
	Guaranteed income (% of lowest income)	51.5%			59.4%			65.2%		

Table B.3: Public Good=20,000, ε_{low}=0, ε_{high}=0.25, lowest α_i for low incomes = 1

Distribution of α_i in low income groups	Outcome Reported	v=0.15			v=0.20			v=0.25		
		w1	w2-w6	w7-w11	w1	w2-w6	w7-w11	w1	w2-w6	w7-w11
		0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000
α_i~ U(1,0.5)	Average tax rate	-8.4%	54.7%	59.0%	-1.8%	58.8%	64.2%	4.5%	62.2%	68.0%
	Average m.t. rate	-8.4%	83.7%	54.1%	-1.8%	87.0%	60.4%	4.5%	89.2%	64.9%
	avg. job partiality	12.8%	57.4%	69.5%	10.2%	56.7%	67.9%	7.8%	55.9%	66.4%
	normalized partiality	22.7%	102.1%	123.6%	18.1%	100.7%	120.7%	13.9%	99.4%	118.1%
	h	7.37%	33%	36%	5.48%	32%	36%	3.97%	31%	36%
	avg. η	1.629	0.095	-	2.095	0.086	-	2.538	0.071	-
	Non-Employment %	23.4%			26.6%			29.1%		
	Guaranteed income (% of lowest income)	52.9%			60.3%			65.7%		
α_i~ U(1,0.4)	Average tax rate	-8.2%	54.5%	58.9%	-1.2%	58.7%	64.1%	5.1%	62.1%	67.9%
	Average m.t. rate	-8.2%	83.5%	53.9%	-1.2%	86.8%	60.2%	5.1%	89.0%	64.7%
	avg. job partiality	20.1%	56.8%	69.5%	18.0%	55.5%	67.9%	16.0%	54.2%	66.3%
	normalized partiality	35.8%	100.9%	123.6%	31.9%	98.6%	120.6%	28.5%	96.3%	117.9%
	h	9.64%	35%	36%	8.01%	34%	36%	6.75%	33%	36%
	avg. η	0.996	0.089	-	1.173	0.087	-	1.310	0.082	-
	Non-Employment %	19.6%			22.4%			24.5%		
	Guaranteed income (% of lowest income)	53.3%			60.9%			66.3%		
α_i ~ U(1,0.3)	Average tax rate	-8.0%	54.2%	58.8%	-0.9%	58.5%	64.0%	5.5%	61.9%	67.8%
	Average m.t. rate	-8.0%	83.4%	53.8%	-0.9%	86.7%	60.1%	5.5%	88.9%	64.6%
	avg. job partiality	27.5%	57.2%	69.5%	25.9%	55.5%	67.8%	24.4%	54.0%	66.3%
	normalized partiality	49.0%	101.6%	123.5%	46.0%	98.7%	120.6%	43.3%	95.9%	117.8%
	h	11.26%	36%	36%	9.85%	35%	36%	8.73%	34%	36%
	avg. η	0.719	0.081	-	0.813	0.082	-	0.885	0.080	-
	Non-Employment %	16.9%			19.3%			21.2%		
	Guaranteed income (% of lowest income)	53.7%			61.4%			67.0%		
α_i~ U(1,0.2)	Average tax rate	-7.9%	54.0%	58.7%	-0.7%	58.2%	64.0%	5.8%	61.7%	67.8%
	Average m.t. rate	-7.9%	83.3%	53.7%	-0.7%	86.6%	60.0%	5.8%	88.8%	64.5%
	avg. job partiality	35.0%	58.1%	69.4%	33.8%	56.3%	67.7%	32.8%	54.6%	66.2%
	normalized partiality	62.2%	103.3%	123.5%	60.2%	100.1%	120.4%	58.3%	97.1%	117.6%
	h	12.47%	37%	36%	11.22%	36%	36%	10.22%	35%	36%
	avg. η	0.563	0.073	-	0.624	0.075	-	0.667	0.075	-
	Non-Employment %	14.9%			17.0%			18.7%		
	Guaranteed income (% of lowest income)	54.2%			62.1%			67.8%		

Table B.4: Public Good=25,050, $\varepsilon_{\mathrm{low}}$=0, $\varepsilon_{\mathrm{high}}$=0.5, lowest α_i for low incomes = 0.9

Distribution of α_i in low income groups	Outcome Reported	v=0.15			v=0.20			v=0.25		
		w1	w2-w6	w7-w11	w1	w2-w6	w7-w11	w1	w2-w6	w7-w11
		0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000
α_i ~ U(0.9,0.4)	Average tax rate	-0.2%	51.2%	47.2%	7.9%	56.3%	53.1%	5.7%	57.1%	56.4%
	Average m.t. rate	-0.2%	72.3%	36.6%	7.9%	76.8%	42.7%	5.7%	80.0%	47.4%
	avg. job partiality	27.8%	58.0%	74.1%	26.1%	57.7%	73.3%	25.9%	57.5%	73.1%
	normalized partiality	49.4%	103.0%	131.7%	46.5%	102.5%	130.4%	46.1%	102.3%	129.9%
	H	21.40%	43%	36%	18.76%	41%	36%	18.46%	41%	36%
	avg. η	0.210	0.000	-	0.328	0.000	-	0.352	0.009	-
	Non-Employment %	0.0%			4.4%			4.9%		
	Guaranteed income (% of lowest income)	11.2%			17.8%			19.2%		
α_i~ U(0.9,0.3)	Average tax rate	0.9%	51.3%	47.2%	8.6%	56.4%	53.1%	4.0%	56.4%	56.1%
	Average m.t. rate	0.9%	72.0%	36.6%	8.6%	76.7%	42.7%	4.0%	80.0%	47.4%
	avg. job partiality	33.2%	59.8%	74.0%	31.9%	59.2%	73.2%	32.0%	59.1%	73.1%
	normalized partiality	59.0%	106.2%	131.6%	56.7%	105.3%	130.2%	56.8%	105.1%	129.9%
	H	21.14%	43%	36%	18.91%	41%	36%	19.00%	41%	36%
	avg. η	0.187	0.000	-	0.282	0.000	-	0.289	0.010	-
	Non-Employment %	0.4%			4.2%			4.0%		
	Guaranteed income (% of lowest income)	12.0%			18.8%			19.4%		
α_i~ U(0.9,0.2)	Average tax rate	3.1%	52.6%	47.7%	8.4%	55.8%	52.9%	2.7%	55.8%	55.9%
	Average m.t. rate	3.1%	72.6%	36.6%	8.4%	76.1%	42.7%	2.7%	79.9%	47.4%
	avg. job partiality	38.5%	61.4%	73.8%	37.9%	61.0%	73.3%	38.0%	60.9%	73.1%
	normalized partiality	68.5%	109.2%	131.2%	67.5%	108.4%	130.2%	67.5%	108.2%	129.9%
	H	20.58%	42%	36%	19.27%	41%	36%	19.37%	41%	36%
	avg. η	0.185	0.000	-	0.238	0.001	-	0.246	0.010	-
	Non-Employment %	1.4%			3.5%			3.4%		
	Guaranteed income (% of lowest income)	14.2%			18.9%			19.6%		
α_i~ U(0.9,0.1)	Average tax rate	3.3%	52.1%	47.5%	7.3%	55.1%	52.7%	1.2%	55.1%	55.7%
	Average m.t. rate	3.3%	72.1%	36.6%	7.3%	76.0%	42.7%	1.2%	79.9%	47.4%
	avg. job partiality	44.3%	63.3%	73.8%	44.0%	62.8%	73.3%	44.0%	62.7%	73.1%
	normalized partiality	78.7%	112.5%	131.2%	78.2%	111.6%	130.2%	78.2%	111.4%	129.9%
	H	20.65%	42%	36%	19.56%	42%	36%	19.65%	42%	36%
	avg. η	0.163	0.000	-	0.208	0.002	-	0.214	0.011	-
	Non-Employment %	1.3%			3.0%			3.0%		
	Guaranteed income (% of lowest income)	14.4%			18.9%			19.7%		

Table B.5: Public Good=20,000, ε_{low}=0, $\varepsilon_{\text{high}}$=0.5, lowest α_i for low incomes = 0.9

Distribution of α_i in low income groups	Outcome Reported	v=0.15			v=0.20			v=0.25		
		w1	w2-w6	w7-w11	w1	w2-w6	w7-w11	w1	w2-w6	w7-w11
		0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000
α_i ~ U(0.9,0.4)	Average tax rate	-13.6%	45.7%	45.1%	-16.1%	47.0%	49.5%	-11.6%	51.3%	54.2%
	Average m.t. rate	-13.6%	71.5%	36.7%	-16.1%	75.9%	42.8%	-11.6%	80.3%	47.6%
	avg. job partiality	26.3%	57.7%	73.4%	25.8%	57.5%	73.0%	24.7%	57.1%	72.3%
	normalized partiality	46.7%	102.6%	130.4%	45.9%	102.2%	129.7%	44.0%	101.6%	128.5%
	h	19.01%	41%	36%	18.34%	41%	36%	16.79%	40%	36%
	avg. η	0.385	0.044	-	0.438	0.068	-	0.532	0.077	-
	Non-Employment %	3.9%			5.1%			7.7%		
	Guaranteed income (% of lowest income)	21.1%			24.1%			29.4%		
α_i~ U(0.9,0.3)	Average tax rate	-14.4%	45.3%	45.0%	-15.7%	47.0%	49.6%	-11.4%	51.1%	54.2%
	Average m.t. rate	-14.4%	71.5%	36.7%	-15.7%	75.9%	42.8%	-11.4%	80.2%	47.6%
	avg. job partiality	32.2%	59.3%	73.4%	31.8%	59.0%	72.9%	31.0%	58.5%	72.2%
	normalized partiality	57.3%	105.5%	130.4%	56.5%	105.0%	129.7%	55.1%	104.0%	128.4%
	h	19.43%	42%	36%	18.73%	41%	36%	17.45%	40%	36%
	avg. η	0.313	0.039	-	0.360	0.059	-	0.427	0.067	-
	Non-Employment %	3.3%			4.4%			6.6%		
	Guaranteed income (% of lowest income)	21.2%			24.7%			29.9%		
α_i ~ U(0.9,0.2)	Average tax rate	-15.1%	45.0%	44.9%	-15.3%	46.9%	49.6%	-11.1%	51.1%	54.2%
	Average m.t. rate	-15.1%	71.5%	36.7%	-15.3%	75.8%	42.8%	-11.1%	80.2%	47.5%
	avg. job partiality	38.2%	61.1%	73.4%	37.8%	60.7%	72.9%	37.3%	60.1%	72.2%
	normalized partiality	67.8%	108.6%	130.4%	67.2%	107.9%	129.6%	66.2%	106.8%	128.3%
	h	19.72%	42%	36%	19.00%	41%	36%	17.89%	41%	36%
	avg. η	0.264	0.035	-	0.304	0.051	-	0.357	0.059	-
	Non-Employment %	2.8%			4.0%			5.9%		
	Guaranteed income (% of lowest income)	21.3%			25.2%			30.5%		
α_i ~ U(0.9,0.1)	Average tax rate	-15.7%	44.7%	44.8%	-15.0%	46.9%	49.7%	-10.8%	51.0%	54.3%
	Average m.t. rate	-15.7%	71.5%	36.6%	-15.0%	75.8%	42.8%	-10.8%	80.2%	47.5%
	avg. job partiality	44.1%	62.9%	73.4%	43.9%	62.5%	72.8%	43.6%	61.8%	72.1%
	normalized partiality	78.4%	111.8%	130.4%	78.0%	111.0%	129.5%	77.5%	109.8%	128.2%
	h	19.93%	42%	36%	19.21%	41%	36%	18.22%	41%	36%
	avg. η	0.228	0.032	-	0.266	0.046	-	0.309	0.053	-
	Non-Employment %	2.4%			3.6%			5.3%		
	Guaranteed income (% of lowest income)	21.4%			25.7%			31.2%		

Table B.6: Public Good=20,000, ε_{low}=0, ε_{high}=0.5, lowest α_i for low incomes = 1

Distribution of α_i in low income groups	Outcome Reported	v=0.15			v=0.20			v=0.25		
		w1	w2-w6	w7-w11	w1	w2-w6	w7-w11	w1	w2-w6	w7-w11
		0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000
α_i~ U(1,0.5)	Average tax rate	-8.3%	49.2%	46.8%	-2.6%	53.5%	52.4%	3.1%	57.1%	56.8%
	Average m.t. rate	-8.3%	73.4%	37.2%	-2.6%	77.8%	43.4%	3.1%	81.0%	48.1%
	avg. job partiality	19.5%	58.5%	73.1%	17.8%	58.4%	72.3%	16.3%	58.2%	71.6%
	normalized partiality	34.7%	104.0%	129.9%	31.6%	103.8%	128.5%	29.0%	103.4%	127.3%
	H	13.71%	38%	36%	11.83%	36%	36%	10.37%	35%	36%
	avg. η	0.576	0.068	-	0.734	0.076	-	0.856	0.078	-
	Non-Employment %	12.9%			16.0%			18.4%		
	Guaranteed income (% of lowest income)	23.8%			29.6%			33.7%		
α_i ~ U(1,0.4)	Average tax rate	-8.3%	49.1%	46.7%	-2.4%	53.3%	52.3%	3.3%	57.0%	56.7%
	Average m.t. rate	-8.3%	73.3%	37.1%	-2.4%	77.7%	43.3%	3.3%	80.8%	48.0%
	avg. job partiality	25.5%	59.2%	73.0%	24.1%	58.7%	72.3%	22.9%	58.2%	71.6%
	normalized partiality	45.4%	105.3%	129.8%	42.9%	104.4%	128.5%	40.7%	103.5%	127.2%
	H	14.88%	38%	36%	13.31%	37%	36%	12.07%	37%	36%
	avg. η	0.443	0.059	-	0.547	0.067	-	0.621	0.070	-
	Non-Employment %	10.9%			13.5%			15.6%		
	Guaranteed income (% of lowest income)	24.3%			30.1%			34.3%		
α_i~ U(1,0.3)	Average tax rate	-8.1%	49.0%	46.6%	-2.1%	53.3%	52.3%	3.6%	56.9%	56.6%
	Average m.t. rate	-8.1%	73.2%	37.0%	-2.1%	77.6%	43.2%	3.6%	80.7%	47.9%
	avg. job partiality	31.6%	60.3%	73.0%	30.5%	59.6%	72.2%	29.5%	58.9%	71.5%
	normalized partiality	56.1%	107.2%	129.8%	54.2%	106.0%	128.4%	52.5%	104.8%	127.1%
	H	15.73%	39%	36%	14.34%	38%	36%	13.25%	37%	36%
	avg. η	0.360	0.052	-	0.437	0.059	-	0.493	0.063	-
	Non-Employment %	9.5%			11.8%			13.6%		
	Guaranteed income (% of lowest income)	24.8%			30.8%			35.1%		
α_i~ U(1,0.2)	Average tax rate	-8.0%	48.9%	46.6%	-2.2%	53.1%	52.2%	3.8%	56.8%	56.6%
	Average m.t. rate	-8.0%	73.1%	37.0%	-2.2%	77.5%	43.1%	3.8%	80.7%	47.9%
	avg. job partiality	37.7%	61.6%	73.0%	36.9%	60.8%	72.2%	36.3%	60.0%	71.4%
	normalized partiality	66.9%	109.5%	129.7%	65.7%	108.1%	128.3%	64.5%	106.7%	126.9%
	H	16.35%	39%	36%	15.14%	39%	36%	14.15%	38%	36%
	avg. η	0.306	0.046	-	0.366	0.053	-	0.408	0.057	-
	Non-Employment %	8.5%			10.5%			12.1%		
	Guaranteed income (% of lowest income)	25.3%			31.4%			35.9%		

Table B.7: Public Good=25,050, endogenous ε_{low} and ε_{high} , lowest α_i for low incomes=0.9

Distribution of αi in low income groups	Outcome Reported	v=0.15			v=0.20			v=0.25		
		w1	w2-w6	w7-w11	w1	w2-w6	w7-w11	w1	w2-w6	w7-w11
		0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000
αi ~ U(0.9,0.4)	Average tax rate	5.4%	43.8%	72.7%	8.1%	48.1%	75.3%	10.7%	51.6%	77.2%
	Average m.t. rate	5.4%	71.0%	91.8%	8.1%	75.1%	93.3%	10.7%	78.2%	94.2%
	avg. job partiality	16.3%	55.0%	66.8%	15.1%	54.4%	65.5%	14.1%	53.8%	64.3%
	normalized partiality	29.0%	97.8%	118.8%	26.9%	96.7%	116.5%	25.1%	95.6%	114.4%
	h	8.30%	37%	36%	7.43%	36%	36%	6.75%	36%	36%
	avg. η	1.268	0.136	-	1.365	0.134	-	1.437	0.130	-
	avg. ε	0.896	0.148	0.043	0.989	0.154	0.045	1.054	0.157	0.047
	Non-Employment %	18.9%			20.5%			21.8%		
	Guaranted income (% of lowest income)	64.8%			68.5%			70.9%		
αi ~ U(0.9,0.3)	Average tax rate	4.0%	45.9%	73.5%	6.8%	50.3%	76.2%	9.7%	53.9%	78.2%
	Average m.t. rate	4.0%	74.2%	91.6%	6.8%	78.5%	93.0%	9.7%	81.6%	94.1%
	avg. job partiality	24.5%	55.5%	66.3%	23.7%	54.6%	64.8%	22.9%	53.8%	63.6%
	normalized partiality	43.6%	98.7%	117.9%	42.1%	97.1%	115.3%	40.8%	95.6%	113.0%
	h	10.33%	38%	36%	9.62%	37%	36%	9.07%	36%	36%
	avg. η	0.882	0.114	-	0.928	0.113	-	0.956	0.110	-
	avg. ε	0.472	0.122	0.044	0.509	0.128	0.047	0.534	0.131	0.048
	Non-Employment %	16.3%			17.7%			18.8%		
	Guaranted income (% of lowest income)	66.9%			70.5%			72.8%		
αi ~ U(0.9,0.2)	Average tax rate	1.8%	48.3%	74.4%	4.7%	52.7%	77.1%	7.7%	56.2%	79.2%
	Average m.t. rate	1.8%	78.0%	91.3%	4.7%	82.2%	92.8%	7.7%	85.3%	93.9%
	avg. job partiality	33.0%	56.3%	65.7%	32.4%	55.2%	64.1%	31.9%	54.2%	62.7%
	normalized partiality	58.6%	100.1%	116.8%	57.6%	98.1%	114.0%	56.8%	96.3%	111.5%
	H	11.85%	38%	36%	11.27%	37%	36%	10.83%	37%	36%
	avg. η	0.678	0.098	-	0.703	0.097	-	0.717	0.096	-
	avg. ε	0.245	0.104	0.046	0.260	0.110	0.048	0.269	0.112	0.050
	Non-Employment %	14.5%			15.6%			16.5%		
	Guaranted income (% of lowest income)	69.1%			72.5%			74.5%		
αi ~ U(0.9,0.1)	Average tax rate	-2.8%	51.1%	75.4%	0.6%	55.2%	78.1%	4.5%	58.4%	80.1%
	Average m.t. rate	-2.8%	83.1%	91.0%	0.6%	86.9%	92.6%	4.5%	89.3%	93.8%
	avg. job partiality	41.5%	57.2%	65.0%	41.3%	55.9%	63.3%	41.0%	54.9%	61.9%
	normalized partiality	73.8%	101.6%	115.5%	73.4%	99.4%	112.5%	72.9%	97.5%	110.0%
	H	13.13%	38%	36%	12.65%	38%	36%	12.24%	37%	36%
	avg. η	0.551	0.086	-	0.565	0.086	-	0.573	0.084	-
	avg. ε	0.101	0.091	0.047	0.106	0.095	0.049	0.108	0.098	0.051
	Non-Employment %	13.0%			14.0%			14.8%		
	Guaranted income (% of lowest income)	71.4%			74.4%			76.0%		

Table B.8: Public Good=25,050, endogenous ε_{low} and ε_{high} , lowest α_i for low incomes =1

Distribution of αi in low income groups	Outcome Reported	v=0.15			v=0.20			v=0.25		
		w1	w2-w6	w7-w11	w1	w2-w6	w7-w11	w1	w2-w6	w7-w11
		0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000
αi ~ U(1,0.5)	Average tax rate	9.2%	45.2%	73.1%	12.6%	49.5%	75.7%	15.8%	53.1%	77.7%
	Average m.t. rate	9.2%	70.4%	92.0%	12.6%	74.4%	93.4%	15.8%	77.4%	94.3%
	avg. job partiality	7.1%	56.6%	66.7%	5.4%	56.1%	65.3%	3.9%	55.7%	64.1%
	normalized partiality	12.6%	100.6%	118.6%	9.6%	99.8%	116.1%	7.0%	99.0%	114.0%
	H	3.55%	34%	36%	2.59%	33%	36%	1.84%	33%	36%
	avg. η	2.477	0.136	-	2.844	0.128	-	3.134	0.118	-
	avg. ε	2.182	0.173	0.043	2.568	0.176	0.046	2.865	0.175	0.047
	Non-Employment %	26.5%			28.3%			29.7%		
	Guaranted income (% of lowest income)	65.0%			68.6%			70.9%		
αi ~ U(1,0.4)	Average tax rate	8.7%	47.1%	73.8%	12.2%	51.6%	76.5%	15.6%	55.3%	78.6%
	Average m.t. rate	8.7%	73.0%	91.7%	12.2%	77.1%	93.2%	15.6%	80.3%	94.2%
	avg. job partiality	15.4%	56.0%	66.2%	14.0%	55.1%	64.7%	12.8%	54.3%	63.4%
	normalized partiality	27.3%	99.5%	117.7%	24.9%	98.0%	115.1%	22.8%	96.6%	112.7%
	H	6.34%	35%	36%	5.54%	35%	36%	4.93%	34%	36%
	avg. η	1.323	0.115	-	1.422	0.111	-	1.487	0.106	-
	avg. ε	0.943	0.143	0.044	1.037	0.148	0.047	1.098	0.150	0.048
	Non-Employment %	22.7%			24.2%			25.4%		
	Guaranted income (% of lowest income)	66.8%			70.3%			72.5%		
αi ~ U(1,0.3)	Average tax rate	7.7%	49.1%	74.5%	11.4%	53.7%	77.4%	15.0%	57.4%	79.5%
	Average m.t. rate	7.7%	75.9%	91.4%	11.4%	80.2%	93.0%	15.0%	83.2%	94.0%
	avg. job partiality	23.8%	56.0%	65.7%	22.8%	54.8%	64.0%	21.9%	53.8%	62.6%
	normalized partiality	42.4%	99.5%	116.8%	40.5%	97.5%	113.9%	39.0%	95.7%	111.3%
	H	8.36%	36%	36%	7.70%	35%	36%	7.18%	35%	36%
	avg. η	0.906	0.100	-	0.949	0.097	-	0.974	0.093	-
	avg. ε	0.490	0.122	0.046	0.526	0.127	0.048	0.546	0.130	0.049
	Non-Employment %	20.0%			21.2%			22.2%		
	Guaranted income (% of lowest income)	68.7%			72.1%			74.0%		
αi ~ U(1,0.2)	Average tax rate	5.7%	51.3%	75.4%	9.6%	56.0%	78.3%	13.9%	59.6%	80.4%
	Average m.t. rate	5.7%	79.5%	91.2%	9.6%	83.6%	92.8%	13.9%	86.4%	93.9%
	avg. job partiality	32.5%	56.4%	65.0%	31.8%	55.0%	63.3%	31.3%	53.8%	61.8%
	normalized partiality	57.8%	100.2%	115.6%	56.6%	97.8%	112.5%	55.6%	95.7%	109.8%
	H	9.95%	36%	36%	9.39%	36%	36%	8.93%	36%	36%
	avg. η	0.689	0.088	-	0.713	0.086	-	0.725	0.083	-
	avg. ε	0.253	0.106	0.047	0.266	0.111	0.049	0.272	0.114	0.050
	Non-Employment %	17.9%			19.0%			19.9%		
	Guaranted income (% of lowest income)	70.7%			73.8%			75.4%		

Table B.9: Public Good=40,000, endogenous ε_{low} and ε_{high} , lowest α_i for low incomes =1

Distribution of αi in low income groups	Outcome Reported	v=0.15			v=0.20			v=0.25		
		w1	w2-w6	w7-w11	w1	w2-w6	w7-w11	w1	w2-w6	w7-w11
		0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000	0-4500	4500-10000	10000-40000
αi ~ U(1,0.5)	Average tax rate	5.7%	49.7%	77.5%	8.8%	53.3%	79.3%	11.9%	56.4%	80.8%
	Average m.t. rate	5.7%	78.8%	95.9%	8.8%	81.8%	96.5%	11.9%	84.0%	96.9%
	avg. job partiality	16.6%	57.6%	70.2%	15.5%	57.3%	69.3%	14.6%	57.1%	68.5%
	normalized partiality	29.6%	102.3%	124.8%	27.6%	101.9%	123.2%	25.9%	101.5%	121.7%
	H	10.69%	38%	36%	9.65%	37%	36%	8.80%	36%	36%
	avg. η	0.790	0.090	-	0.885	0.093	-	0.955	0.093	-
	avg. ε	0.543	0.087	0.020	0.622	0.093	0.022	0.687	0.098	0.024
	Non-Employment %	16.0%			17.8%			19.2%		
	Guaranted income (% of lowest income)	31.5%			34.6%			36.8%		
αi ~ U(1,0.4)	Average tax rate	4.6%	51.5%	78.2%	7.9%	55.1%	80.1%	11.1%	58.2%	81.5%
	Average m.t. rate	4.6%	81.5%	95.6%	7.9%	84.4%	96.3%	11.1%	86.6%	96.8%
	avg. job partiality	23.0%	58.0%	69.8%	22.1%	57.6%	68.8%	21.3%	57.2%	67.9%
	normalized partiality	40.9%	103.2%	124.0%	39.3%	102.4%	122.3%	37.9%	101.6%	120.7%
	h	12.16%	38%	36%	11.30%	37%	36%	10.63%	37%	36%
	avg. η	0.605	0.078	-	0.661	0.080	-	0.700	0.081	-
	avg. ε	0.338	0.072	0.022	0.377	0.078	0.024	0.406	0.081	0.025
	Non-Employment %	14.0%			15.5%			16.7%		
	Guaranted income (% of lowest income)	33.4%			36.5%			38.6%		
αi ~ U(1,0.3)	Average tax rate	3.1%	53.2%	78.9%	6.5%	56.9%	80.8%	10.1%	59.8%	82.2%
	Average m.t. rate	3.1%	84.3%	95.4%	6.5%	87.2%	96.1%	10.1%	89.2%	96.7%
	avg. job partiality	29.5%	58.8%	69.3%	28.9%	58.2%	68.2%	28.3%	57.6%	67.3%
	normalized partiality	52.5%	104.5%	123.2%	51.3%	103.4%	121.3%	50.3%	102.5%	119.6%
	H	13.26%	38%	36%	12.56%	38%	36%	11.99%	37%	36%
	avg. η	0.494	0.069	-	0.530	0.071	-	0.553	0.071	-
	avg. ε	0.209	0.061	0.023	0.229	0.066	0.025	0.244	0.069	0.026
	Non-Employment %	12.6%			13.9%			14.9%		
	Guaranted income (% of lowest income)	35.3%			38.2%			40.1%		
αi ~ U(1,0.2)	Average tax rate	1.1%	54.9%	79.5%	4.9%	58.4%	81.4%	9.0%	61.3%	82.9%
	Average m.t. rate	1.1%	87.1%	95.2%	4.9%	89.8%	96.0%	9.0%	91.5%	96.5%
	avg. job partiality	36.3%	59.7%	68.8%	35.8%	59.0%	67.7%	35.4%	58.4%	66.7%
	normalized partiality	64.5%	106.2%	122.4%	63.7%	104.9%	120.4%	63.0%	103.8%	118.6%
	H	14.14%	39%	36%	13.54%	38%	36%	13.04%	38%	36%
	avg. η	0.418	0.061	-	0.441	0.063	-	0.458	0.063	-
	avg. ε	0.120	0.054	0.024	0.131	0.058	0.026	0.136	0.060	0.027
	Non-Employment %	11.5%			12.6%			13.5%		
	Guaranted income (% of lowest income)	37.0%			39.8%			41.6%		

Appendix C - Simulations Methodology

C.1 Simulation population

In the logarithmic case, the simulation was comprised of 28,000 virtual individuals, who were divided into 11 wage groups, corresponding to the following maximum group sizes (which is obtained if all individuals with a given wage level actually work): max(N1)=6,000, max(N2)=4,000, max(Nj)=2,000 $\forall$ j $\in [3,4,\ldots,11]$. The (endogenous) number of individuals who are not employed is denoted by $\mathrm{N_0}$ $\left(\mathrm{N_0} = 28{,}000 - \sum_{j=0}^{11} \mathrm{N_j}\right)$. In the constant labor elasticity case we performed a different grouping (explained below) and consequently the sample is smaller – 26,000 virtual individuals.

According to the model shown above, each individual decides whether or not to work, and for what portion of his time, according to the government guaranteed income, his individual leisure preferences, wages, and tax rates. As in the Saez model the (endogenous) relative size of each group $\mathrm{h_i}$ is defined as $\mathrm{h_i} = \frac{\mathrm{N_j}}{\sum_{j=0}^{11} \mathrm{N_j}}$. It thus follows that $\sum_{j=0}^{11} \mathrm{h_j} = 1$.

C.2 Choice of wage groups

Wage groups were chosen in accordance with the estimated wage distribution in Israel in 2012 – which was computed from the Israeli CBS' 2012 Expenditures & Income survey. Employed individuals in the survey were divided (in ascending order) into 14 groups of equal size, and the average wage for each of these groups was then computed. The combined average wage for the 3 bottom groups corresponds to W1;

the combined average wage for groups 4-5 corresponds to W2; the average wages of groups 6-14 correspond (respectively) to W3-W11.

In the constant labor elasticity case the inexistence of income effects implies that the choice of q makes the difference between labor market participating and non-participating individuals. In order to have a realistic range for the EITC we re-arranged the groups so as to allow non-participation at the range between 2000 and 4300 NIS, as compared to 0-4500 NIS in the logarithmic case. Roughly this new arrangement implies that working groups 1 remains alone, and groups 2 until 6 were set together as W2, while 6 until 14 correspond to W3-W11.

C.3 The government's redistributive tastes

As in the Saez Model, the function $g(\cdot)$ is taken as exogenous and reflects the absolute redistributive tastes of the government. $g_j = \frac{1}{0.79 \cdot {w_j}^v}$, where v is an exogenous parameter that represents the magnitude of the government's redistributive tastes. Saez (2002) multiplies the welfare weights (that appear in the denominator) by the shadow price of public funds, according to a simulation using US data. In our case, we use the share of funds available to the government from every dollar (or Shekel) collected in taxes (i.e. collection costs are 21 cents for every dollar); thus, we multiply by 0.79, which in our case, serves as an estimate of the shadow price of government intervention. In the simulations we use three values for v: 0.15, 0.2 and 0.25.

C.4 Level of guaranteed income

As in Saez (2002), the level of guaranteed income is determined endogenously, subject to the budget constraint. For this purpose we used Israeli data for 2012, by looking at the direct tax revenues in Israel, including the income tax, the corporate tax and the capital tax. Like Saez, we assume that the government wants to collect the same amount that is actually collected with the income tax (state and federal) net of redistribution done with the earned income tax credit, and other cash transfers. Thus, we also excluded the National insurance institute tax revenues. The more taxes are collected, the higher is the level of guaranteed income. The level of guaranteed income therefore depends on the (optimal) tax scheme that is in place. However, as we shall demonstrate, when income effects are factored in, the optimal tax scheme also depends on the level of guaranteed income (a two way relationship).

C.5 The intensive margin elasticity

Endogenous intensive elasticity: Similar to the extensive margin case, the intensive elasticity in our model is endogenous, as income effects are factored in. For a given wage group N_i the intensive elasticity ε_j is defined in our model as the ratio between the percentage change in the average income from work in a given group $\bar{l_i}w_j$ given a one percent change in w_j. 17

As in the case of the extensive margin, the individual's labor decision is defined by equation(3) $l_i = 1 - \alpha\left(1 + \frac{T_0}{\beta_j w_j}\right)$. And as noted, deriving (3) with respect to w_i yields $\frac{\partial l_i}{\partial w_i} = \frac{\alpha_i T_0}{\beta_i {w_i}^2}$. Thus the magnitude of the endogenous intensive elasticity increases with T_0 and α_i and diminishes with w_j. In other words, people with low

17 For consistency we also used here a 15 percent change in income. It is worth stressing that changes in this number do not produce a substantial change in both extensive and intensive elasticities.

wages, high leisure preferences, and high levels of guaranteed income, have the highest intensive elasticity (provided that they work). Note that a rise in the level of guaranteed income T_0, induces a significant rise in the intensive elasticity ε_j, due to the higher $\frac{T_0}{\beta_i w_i}$ ratio, but leisure-loving individuals leave the workforce, and the entry-level's α_i drops (i.e. only workers with lower leisure preferences work), and this slightly offsets the rise in ε_j. However, when the average α is low, a rise in T_0 induces only a small decrease in the average job partiality in each group: the decline in job partiality of the less leisure loving workers who remain in the workforce is offset by the fact that the workers with lower job partiality leave the workforce altogether – and by doing so they improve the average.

Exogenous intensive elasticity: In order to obtain a better understanding of the mechanism that determines the optimal tax scheme in a fully endogenous model, we also run simulations with a semi-endogenous model, in which the extensive elasticity η_j is endogenous, but the intensive elasticity ε_j is exogenous. Since we are interested in the scenarios which yield EITC for the low income groups (w_1, w_2), we use for these groups the exogenous ε_j value used in Saez's simulations, i.e., $\varepsilon_j = 0$, that yielded the highest rates of EITC . For the higher income groups $(w_3 - w_{11})$, we use the two ε_j values used by Saez: $\varepsilon_j = 0.25, \varepsilon_j = 0.5$. The use of a higher exogenous elasticity for high-income individuals relatively to low-income ones is in line with the empirical findings of Gruber and Saez (2002).

Computation of average job partiality when ε_j is exogenous: It is important to note that when exogenous intensive elasticity is assumed, the average job partiality in the logarithmic case is computed differently from the fully endogenous case. While in the fully endogenous case, the average job partiality is derived directly from the virtual individuals' labor choices, given the tax rate and the level of guaranteed income; in the semi-endogenous case, the average job partiality is computed in two stages. In the first stage, only income effects are factored in (i.e. only the guaranteed income affects job partiallity), and the before-tax average job partiality is computed. This first-stage average job partiality is then multiplied by $\left(1 - t_j \varepsilon_j\right)$. This means, for example, that a 30% marginal tax rate and an exogenous intensive elasticity of 0.5, reduce the average job partiality by 15%. Thus the average after-tax job partiality would be 85% of the before-tax job-partiality. It is important to note that these differences in the manner of computation of the average job partiality also affect the (computed) sum of tax revenues in each of these scenarios.

Appendix D: A model with Constant Elasticity of labor supply

Another empirically relevant case is when we apply equation 1 to the case in which u(c)=c, and $v(l) = \frac{l^{1+k}}{1+k}$, which means that there are no income effects and that the labor supply elasticity equals k[18]; i.e., in this case:

D.1) $U_i(c, 1-l) = \mathrm{c} - \alpha_i \frac{{l_i}^{1+k}}{1+k} - q.1\,(l > 0)$

$c_i = T_0 + \beta_i w_i l_i$

The upper bound on the fixed cost is

$$q_i = c_i - c_0 - \alpha_i v(l_i)$$

The Lagrange multipliers are:

$$(L)c_i = c_i - \alpha_i \frac{{l_i}^{1+k}}{1+k} + \lambda\,(T_0 + \beta_i w_i l_i - c_i)$$

$$(L_l) \rightarrow \alpha_i\, {l_i}^k = \lambda\, \beta_i w_i$$

$$(L_c) \rightarrow 1 = \lambda$$

Solving for c we receive:

$$\rightarrow 1 = \frac{\alpha_i\, {l_i}^k}{\beta_i w_i}$$

$$\rightarrow l_i = \left(\frac{\beta_i w_i}{\alpha_i}\right)^{\frac{1}{k}}$$

Plugging the solution in the utility function derives in equation D.2:

$$U_i(c, 1-l) = \mathrm{c} - \alpha_i \frac{\left(\frac{\beta_i w_i}{\alpha_i}\right)^{\frac{1+k}{k}}}{1+k} - q > 0$$

$$\rightarrow U_i(c, 1-l) = \beta_i w_i \cdot \left(\frac{\beta_i w_i}{\alpha_i}\right)^{\frac{1}{k}} - \alpha_i \frac{\left(\frac{\beta_i w_i}{\alpha_i}\right)^{\frac{1+k}{k}}}{1+k} - q > 0$$

$$\rightarrow U_i(c, 1-l) = \alpha_i^{\frac{-1-k}{k}} \beta_i w_i^{\frac{1+k}{k}} - \frac{\alpha_i^{\frac{-1}{k}} \cdot \beta_i w_i^{\frac{1+k}{k}}}{1+k} - q > 0$$

[18] For an explanation see Saez (2001), page 222. Like in his paper, a further option is to use u(c)=log(c), which will be explored by us soon.

$$\rightarrow U_i(c, 1-l) = \beta_i w_i^{\frac{1+k}{k}}(\alpha_i^{\frac{-1-k}{k}} - \frac{\alpha_i^{\frac{-1}{k}}}{1+k}) - q > 0$$

D.2) $U_i(c, 1-l) = \alpha_i^{\frac{-1}{k}} \beta_i w_i^{\frac{1+k}{k}} (\frac{1}{\alpha_i} - \frac{1}{1+k}) - q > 0$

This equation will be later used in our simulations. As explained in Saez (2002) and Dahan and Strawczynski (2012), a drawback of this solution is that the labor supply tends to infinity. We deal with this undesired characteristic in our simulation by limiting the maximum labor supply.