The Macroeconomics effects of a Negative Income Tax

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Abstract

I study a revenue neutral tax reform from the actual US Income Tax to a Negative Income Tax (N.I.T.) in a life-cycle economy with individual heterogeneity. I compare different transfers in a stationary equilibrium. I find that the optimal tax rate is 19.51% with a transfer of 11% of GDP per capita, roughly $5,172.79. The average welfare gain amounts to a 1.7% annual increase of individual consumption. All agents benefit from the reform. There is a 17.52% increase in GDP per capita and a decrease of 13% in Capital per labor. Capital per Output declines 10.22%.

1 Introduction

The actual US Income Tax has managed to become increasingly complex, because of its numerous tax credits, deductions, overlapping provisions and increasing marginal rates. The Income Tax introduces a considerable number of distortions in the economy. There have been several proposals to simplify it. However, this paper focuses on one of them: a Negative Income Tax (NIT).

In this paper, I ask the following questions: What are the macroeconomic effects of replacing the Income Tax with a Negative Income Tax? Specifically, is there any welfare gain from this Revenue-Neutral Reform? Particularly, I am considering a NIT that taxes all income at the same marginal rate and makes a lump-sum transfer to all households. Not only does the tax proposed is simple but also all households have a minimum income assured.

In order to answer these questions, I calibrate a life-cycle economy, with heterogeneous agents and endogenous labor supply decisions, to match certain features of the US economy, in the spirit of Imrohoroglu, Imrohoroglu, and Joines (1995), Huggett and Ventura (1999), Imrohoroglu (1989) and Huggett (1996), among others.

I consider as a measure of welfare the ex-ante lifetime utility of a newborn in a stationary equilibrium. First, I find that replacing the Income Tax by a proportional tax implies a welfare gain equal to an increase in individual consumption of 1.3% per year. The welfare gain is not positive for all types: agents with low productivity are actually worse off. There is an increase in the hours worked and the labor supply by 28.78% and 25.4% respectively. There is a positive impact on capital accumulation. For example, Capital over output jumps from 2.7 to 2.74. Consumption is 29.18% higher and keeping fixed leisure in its previous levels gives a welfare gain equivalent to an increase in individual consumption equal to 4.9% per year. Highly productive agents are facing a lower income tax rate. Their income is taxed at a marginal rate of 6.49%.

Second, the optimal transfer is 11.02% of the GDP per capita, roughly an annual transfer of $5,172.79, and a tax rate of 19.51%. Therefore, a household earning $30,000 a year pays $680.21 in taxes instead of the $979.5 that actually pays with the current Income Tax. In the optimal case, all types of agents favor the reform and the welfare gain equals an annual increase of individual consumption of 1.7% as a result of the better distribution of resources. Hence, the share of consumption of the low productivity agents increases 16% from 22.95% to 26.59% and total consumption increases 22.48%. Thus, highly productive agents favor lower levels of transfers.

Third, GDP per capita increases by 17.52% and capital per labor decreases 13%. Higher levels of transfer are related to lower levels of GDP per capita and capital accumulation. Hence, Capital per Output decreases to 2.42. Higher the transfer, higher the proportion of productive agents in the labor supply.

Fourth, agents pay taxes when they are working, increasing their tax liabilities when they are more productive in the life-cycle. The net transfer is positive for all agents when they are retired. Also, the proposed tax system is progressive and median productivity agents favor the reform as they were positioned in the kinks of the income bracket and the new tax allows them to smooth consumption more efficiently.

Finally, all agents consume more at all ages with the tax reform.

1.1 Related literature

Juliet Rhys-Williams and Milton Friedman (1962) were the first to develop the concept of a Negative Income tax. Despite of its popularity in the seventies and a failed attempt to introduce it as legislation during Richard Nixon's Presidency, a study of the Negative Income Tax in a general equilibrium setting has been largely neglected due to the computational limitations of the time. Nevertheless, the number of studies in the subject is considerable; see Moffit (2003) and Meltzer (2003) for example.

This paper is part of the literature on optimal taxation (see Mirrlees (1971) and Stern (1976)) and follows a quantitative approach in the same lines as in Ventura (1999), Domeij and Heathcote (2004), Conesa and Krueger (2006) and Conesa, Kitao, and Krueger (2009), among others. Ventura (1999) studies the quantitative general equilibrium implications of a Flat Tax Reform and finds a positive impact in capital accumulation and labor supply, and a higher concentration of earnings and wealth. Domeij and Heathcote (2004) study the effects of reducing capital taxes in two settings: a representative agent and a standard incomplete market model and conclude that the welfare gains of reducing capital taxes are bigger in the former. Conesa and Krueger (2006) analyze the optimal progressivity of the income tax code and find that a flat tax rate of 17.2% and a deduction of $9,400 are optimal for the US, with a welfare gain of 1.7% in indivdual consumption. Conesa, Kitao, and Krueger (2009) allow a distinction between capital and labor income and conclude that in the US, the optimal income tax rate is 36% and a labor tax rate of 23% with a deduction of $7,200.

The paper proceeds as follows: Section 2 describes the model and defines the equilibrium, Section 3 explains the calibration, Section 4 presents the results and Section 5 concludes.

2 The model

2.1 General Framework

I study a general equilibrium life-cycle economy consisting of D overlapping generations. Agents are heterogeneous and face no idiosyncratic risk. There is neither life nor aggregate uncertainty. Time is discrete.

Agents value consumption and leisure. Every period, given competitive prices, they decide how much to consume, save and work. There is an exogenously retirement age and a one-period risk-free asset. Neither borrowing nor short selling is allowed.

Heterogeneity arises from two factors: age and type. A newborn faces a given probability of belonging to one of M different types. Each of them has its own inborn productivity, which is kept constant for the rest of the agent's life[1]. Age also plays a role in productivity. On the other hand, for every type, the agent's efficiency profile evolves through time. Therefore, it is not going to be the same the work in efficiency units supplied to the market by a young, a middle-age and an old agent.

There is a government that collects taxes and runs a balanced budget.

In the following paragraphs, I will give a formal description of the model.

2.2 Demographics

A continuum of agents is born at each date. The size of the newborns is normalized to be equal to one. The mass population at time t is given by N_t and evolves through time at a growth rate n.

All agents live D periods. The first R periods of their life, agents are involved in productive activities and in the following $D-R$, they are retired. The age R is exogenous.

The demographic structure is stationary. Therefore, at any given point in time, the fraction μ_j of age j individuals in the population is constant.

[1]This feature of the model contemplates the fact that agents differ themselves through innate abilities or, for instance, their levels of education.

2.3 Endowment, Preferences and Labor Productivity

Agents are born with zero assets. At every period of their working life, they are endowed with one unit of time that they supply to the market at a competitive wage rate

All agents share the same preferences over streams of leisure and consumption given by the time-separable utility function:

$$\sum_{j=1}^{D} \beta^j u\left(c_{j,t}, 1 - l_{j,t}\right)$$

where $c_{j,t}$ and $l_{j,t}$ stands for consumption and leisure at age $j \in J =$

$\{1, \ldots, D\}$ and period t, respectively. The momentary utility function belongs to the Constant Relative Risk Aversion (CRRA) class and is given by:

$$\frac{\left[c^{\nu}\left(1-l\right)^{1-\nu}\right]^{1-\sigma}}{1-\sigma}$$

These preferences display a unitary intratemporal elasticity of substitution. Consumption and leisure are not separable. The parameter $\nu \in (0, 1)$ shapes the time spent working and σ influences the degree of risk of aversion[2] and the Frisch elasticity of labor supply. The latter gives the elasticity of hours worked to changes in wages, keeping the marginal productivity of consumption constant. The Frisch elasticity is:

$$\eta\left(\nu, \sigma, l\right) = \frac{\left(1-l\right)}{l} \frac{\left[1 - \nu\left(1-\sigma\right)\right]}{\sigma}$$

At the beginning of her life, an agent face a probability $p_i > 0$ of belonging to one of M particular ability types $i \in I = \{1, \ldots, M\}$. The type i together with the age j determine the agent's productivity $e\left(i, j\right) \in E$. Therefore, her productivity is divided into a fixed component given by her type, and a variable one represented by her age.

The pre-tax labor income is equal to $w_t e\left(i, j\right) l_{j,t}$ and the pre-tax capital income equals $r_t\ a_{j,t}$, where $a_{j,t} \in A = \mathbb{R}_+$.

[2]The Arrow-Pratt measure of Relative Risk Aversion ($\rho = -c u''_{cc}\left(c\right)/u'_c\left(c\right)$) is $1 - \nu\left(1-\sigma\right)$.

2.4 Technology

Total output Y_t is produced with a Cobb-Douglas production function with a labor augmenting technology.

$$Y_t = K_t^{\alpha} (A_t L_t)^{1-\alpha}$$

where K_t and L_t are the aggregate capital and labor (measured in efficiency units) at time t. $A_t = A_0 (1+g)^t$ is the labor augmenting technology that increases at a rate g.

In the presence of competitive markets, α is the share of capital income in total output. As I use a Cobb-Douglas production function, I can assume that there is a representative firm operating this technology.

The resource constraint is:

$$C_t + K_{t+1} - K_t (1-\delta) + G_t \leq K_t^{\alpha} (A_t L_t)^{1-\alpha}$$

Following conventional notation, δ is the depreciation rate, G_t is public consumption and C_t is total private consumption.

2.5 Government policies and taxes

At time t, government consumes G_t resources, collects taxes and runs a balanced budget. Agents don't derive any utility from G_t. I consider two tax systems: one that mimics the current Income Tax and the other one based on a Negative Income Tax.

The actual Income Tax system is the benchmark case. Agents pay taxes for their income, defined as the sum of their labor and capital income, according to an income scale given by P brackets. Each of them has a different marginal tax rate τ_i that increases with the position of the bracket and makes the tax system progressive.

Suppose that an agent of age j earns an income $I_{j,t}$ that belongs to the bracket k, i.e., $I_{j,t} \in (I_{k-1}, I_k]$, where $k \in \{1, \ldots, P\}$ and I_k as well as $I_{k-1}$are the bracket's bend points. Then, she pays in taxes the following sum:

$$T_{j,t} = (I_{j,t} - I_{k-1}) \times \tau_k + \ldots + (I_2 - I_1) \times \tau_2 + (I_1 - I_0) \times \tau_1$$

In the other setting, there is only a Negative Income Tax. All agents receive a fixed lump-sum transfer TR_t and pay a constant marginal tax rate τ for every unit of income earned. A type i agent of age j with income $I_{j,t} \equiv w_t e(i,j)\, l + a_t(i,j)\, r$ has a tax liability equal to:

$$T_{j,t} = I_{j,t} \times \tau - TR_t$$

2.6 Agent's Problem: Recursive formulation

In order to express the model in the language of dynamic programming, it is necessary to transform the variables. The transformations are standard:

$$\widehat{a} = \frac{a}{A}, \quad \widehat{l} = l, \quad \widehat{G} = \frac{G}{NA}, \quad \widehat{K} = \frac{K}{NA}, \quad \widehat{L} = \frac{L}{N}, \quad \widehat{w} = \frac{w}{A}, \quad \widehat{r} = r$$

$$T\widehat{R} = \frac{TR}{A}, \quad \widehat{T} = \frac{T}{A}, \quad \widehat{c} = \frac{c}{A}, \quad \widehat{C} = \frac{C}{AN}$$

Time subscripts have been dropped as I focus in a stationary equilibrium. Let $X = A \times I$, then the agent's state variable is the vector (x, j), where $x \in X$ and $j \in J$.

Given prices and a tax regime, the agent's problem is to choose the amount of labor to supply to the market, how much to consume and, therefore, the amount of assets $\widehat{a}'$ to carry over the next period. Optimal decisions rules for consumption $c(x,j)$, labor $l(x,j)$ and next period asset holdings $a(x,j)$ are the functions that solve the following dynamic programming problem:

$$v(x,j) = \max_{\left(\widehat{c},\widehat{l},\widehat{a}'\right)} \left\{ u\left(\widehat{c}, 1-\widehat{l}\right) + \beta (1+g)^{\nu(1-\sigma)} v\left(\widehat{a}', i,\ j+1\right) \right\}$$

subject to

$$\widehat{c} + \widehat{a}'(1+g) \leq \widehat{a}(1+\widehat{r}) + \widehat{w} e(i,j)\, \widehat{l} - \widehat{T}(x,j) \qquad if\ j \leq R$$

$$\widehat{c} \geq 0, \quad \widehat{a} \geq 0, \quad \widehat{a}' \geq 0$$

and

$$\widehat{c} + \widehat{a}'(1+g) \leq \widehat{a}(1+\widehat{r}) - \widehat{T}(x,j) \qquad if\ j > R$$

$$\widehat{c} \geq 0, \quad \widehat{a} \geq 0, \quad \widehat{a}' \geq 0$$

with

$$v(x, D+1) \equiv 0$$

2.7 Equilibrium

Let $(A, \mathcal{A})$, $(I, \mathcal{I})$ and $(J, \mathcal{J})$ be measurable spaces, where $\mathcal{A}$ is the Borel $\sigma-$algebra defined on A; $\mathcal{I}$ and $\mathcal{J}$ are the Power sets defined on I and J respectively.

Let $(X, \mathcal{X}) = (A \times I, \mathcal{A} \times \mathcal{I})$ be a product space, then I can define the probability space $\left(X, \mathcal{X}, \psi_j\right)$, where $\psi_j : \mathcal{X} \to [0, 1]$ is a probability measure. Therefore, the measure of type i agents with asset holdings a within the cohorts of age j is given by $\psi_j(x)$, with $x = (a, i)$. As agents are born with no assets, $\psi_1(x)$ is univocally determined by the probability distribution of the agents' type. For $j > 1$, $\psi_j(x)$ must be consistent with individual decision rules.

Definition 1 *A stationary equilibrium is a collection of decision rules $c(x, j)$, $l(x, j)$ and $a(x, j)$, factor prices $\{\widehat{w}, \widehat{r}\}$, a tax regime, taxes paid $\widehat{T}(x, j)$ and transfers $T\widehat{R}(x, j)$, aggregate capital $\widehat{K}$, and aggregate labor $\widehat{L}$, government consumption $\widehat{G}$, and a collection of invariant distributions $(\psi_1, \ldots, \psi_D)$ such that:*

1. *Decision rules $c(x, j)$, $l(x, j)$ and $a(x, j)$ are optimal*
2. *Factor prices are competitive:*

$$\widehat{w} = F_2\left(\widehat{K}, \widehat{L}\right)$$

$$\widehat{r} = F_1\left(\widehat{K}, \widehat{L}\right) - \delta$$

3. *Market clearing conditions are satisfied:*
   (a) $\sum_j \mu_j \left[\int_X \left(c(x, j) + a(x, j)(1 + g)\right) d\psi_j(x)\right] + \widehat{G} = F\left(\widehat{K}, \widehat{L}\right) + (1 - \delta)\widehat{K}$
   (b) $\sum_j \mu_j \int_X a(x, j)\, d\psi_j(x) = (1 + n)\widehat{K}$
   (c) $\sum_j \mu_j \int_X l(x, j)\, e(i, j)\, d\psi_j(x) = \widehat{L}$

4. *Law motion:*
$$\psi_{j+1}(B) = \int_X P(x,j,B)\, d\psi_j(x)$$
where $P(x,j,B) = 1$ *if* $a(x,j) \in B$, *and* $P(x,j,B) = 0$ *otherwise,* $\forall B \in \mathrm{X}$, $j = 1, \ldots, D$

5. *Government budget is balanced:*
$$\widehat{G} = \sum_j \mu_j \int_X \widehat{T}(x,j)\, d\psi_j(x)$$

3 Calibration

First and foremost, it is necessary to take a stand on the model period which I set equal to 5 years. The selection of the model parameters is described below. Table 1 summarizes the results.

3.1 Demographics

Agents are born at age 20 (model period 1), work for 9 periods, retire at period 10 (age 65) and die in period 12 (age 80). Population grows at a rate of 1.1% annually, in accordance to the US population growth from 1929-2008 (Economic Report of the President 2009, Table B34). Therefore, n is equal to 5.6%

3.2 Preferences

In infinitely-lived models, v is the time spent working. However, as it was pointed out in Rios-Rull (1996), in a life-cycle model the relation is not immediate. I follow Ventura (1999) and set v equal to 1/3.

The coefficient σ influences the agent's risk aversion. I choose $\sigma = 4$ in order to achieve an Intertemporal Elasticity of Substitution (IES) equal to 0.5, which is standard in the literature, i.e., given v, I find the value of σ that gives me the desired IES. This is the same reasoning as in Conesa, Kitao, and Krueger (2009).

The discount factor β is set endogenously in order to obtain a capital-output ratio of 2.7 in stationary equilibrium.

Parameters	Value	Target.
β	0.99	$K/Y = 2.7$.
σ	4	$IES = 0.5$.
ν	1/3	Average time spent working 1/3.
D	12	Maximum Age 80
R	10	Retirement age 65
n	5.6%	1.1% annually.
σ_α^2	0.22	PSID.
μ_α	0	PSID.
α	0.36	Capital share.
δ	25.84%	$I/Y = 25.5\%$.
g	9.87%	1.9% annually.

Table 1: Parameter Selection

3.3 Technology

The capital share α is equal to 0.36 in the same line as in Conesa, Kitao, and Krueger (2009) and Domeij and Heathcote (2004), among others. From the data, I find that the labor augmenting technology A increases at a rate g of 1.9% annually, or equivalently 9.87% in the model.

The depreciation rate δ is chosen in order to assure an investment-output ratio equal to 25.5%, a value used in Conesa, Kitao, and Krueger (2009)'s calculations. Therefore, δ is equal to 25.84%.

3.4 Labor productivity and taxes

As I have said before, the labor productivity $e(i,j)$ consists of two independent components: a deterministic and age-dependent component. Heathcote, Storesletten, and Violante (2008) calibrated a model where the deterministic productivity α follows a Log-normal distribution.

The logarithm of α has an estimated mean μ_α equal to 0 and a variance σ_α^2 equal to 0.22 . Hence, a standard deviation increases wages by roughly 47%. I use their estimations and divide the support of α into 7 parts. Therefore, $\alpha \in \{0.49,\ 0.63,\ 0.79,\ 1,\ 1.26,\ 1.60,\ 2.02\}$ with probabilities 0.11, 0.12, 0.17, 0.20, 0.17, 0.12 and 0.11 respectively.

Income Brackets	Marginal Tax rate
$(0, 0.5\overline{Y}]$	0
$(0.5\overline{Y}, 1.35\overline{Y}]$	15%
$(1.35\overline{Y}, 2.56\overline{Y}]$	28%
$(2.56\overline{Y}, 3.74\overline{Y}]$	31%
$(3.74\overline{Y}, 6.29\overline{Y}]$	36%
$> 6.29\overline{Y}$	39.6%

Table 2: US Federal Income Tax

The age-dependent productivity ε is the weighted average of male and female efficiency profiles shown in Hansen (1993). From the U.S. Census Bureau (June 2009), I use a weight for males of 49%.

The specifications for the actual Income Tax is described in Table 2. I consider the Income Tax for the year 2000, prior the temporary reforms of 2001 and 2003.

The marginal tax rate of the Negative Income Tax is constant for all levels of income and is set endogenously in order to assure the same revenue as the baseline case plus the resources needed to fund the transfers. The latter is a fraction of the GDP per capita. I consider transfers of 0%, 1% and 5%. Also, I calculate the optimal transfer.

4 Results

4.1 Welfare measures

Following Conesa, Kitao, and Krueger (2009), I use as a measure of the welfare gain from the reform, the uniform increase needed in the benchmark case to make the agent indifferent between the two tax systems. Given the utility function used, the Consumption Equivalent Variation (CEV) is going to be defined as:

$$CEV = \left[\frac{W\left(c^*, l^*\right)}{W\left(c_0, l_0\right)}\right]^{\frac{1}{\nu(1-\sigma)}} - 1$$

where $W\left(c^*, l^*\right) = \sum_i^M v\left(0, i, 1\right) \psi_1\left(0, i, 1\right)$, being $c^*\left(c_0\right)$ and $l^*\left(l_0\right)$ the optimal consumption and labor allocations for the reform (baseline) scenario. Therefore,

$$W\left(c^*, l^*\right) = W\left(c_0\left(1 + CEV\right), l_0\right)$$

The CEV can be divided into the welfare gain due to the change in consumption (CEV_c) and the change in leisure (CEV_l). We have

$$CEV_c = \left[\frac{W(c^*, l_0)}{W(c_0, l_0)}\right]^{\frac{1}{\nu(1-\sigma)}} - 1 \qquad \& \qquad CEV_l = \left[\frac{W(c^*, l^*)}{W(c^*, l_0)}\right]^{\frac{1}{\nu(1-\sigma)}} - 1$$

Consequently,

$$(1 + CEV) = (1 + CEV_c)(1 + CEV_l)$$

The changes in these two measures are the result of two effects: a new level for the aggregate variables and a new distribution of resources among the agents.

It is important to extend the decomposition into the level and distributional change in consumption and leisure. For that purpose, I define two new variables: $\widehat{c}_0$ and $\widehat{l}_0$, which are the consumption and labor allocations in the reform scenario keeping the baseline scenario distribution, i.e., $\widehat{c}_0(x,j) = (c_0(x,j)/C_0)\,C^*$ and $\widehat{l}_0(x,j) = \left(l_0(x,j)/\sum l_0(x,j)\right)\sum l^*(x,j)$ [3], where capital letters stand for aggregate variables.

For consumption, I define the level and distributional change as:

$$CEV_c^L = \left[\frac{W(\widehat{c}_0, l_0)}{W(c_0, l_0)}\right]^{\frac{1}{\nu(1-\sigma)}} - 1 \qquad \& \qquad CEV_c^D = \left[\frac{W(c^*, l^*)}{W(\widehat{c}_0, l_0)}\right]^{\frac{1}{\nu(1-\sigma)}} - 1$$

Likewise, for leisure:

$$CEV_l^L = \left[\frac{W\left(c^*, \widehat{l}_0\right)}{W(c^*, l_0)}\right]^{\frac{1}{\nu(1-\sigma)}} - 1 \qquad \& \qquad CEV_l^D = \left[\frac{W(c^*, l^*)}{W\left(c^*, \widehat{l}_0\right)}\right]^{\frac{1}{\nu(1-\sigma)}} - 1$$

Combining the above, I get:

$$\begin{aligned}(1 + CEV_c) &= \left(1 + CEV_c^L\right)\left(1 + CEV_c^D\right) \\ (1 + CEV_l) &= \left(1 + CEV_l^L\right)\left(1 + CEV_l^D\right)\end{aligned}$$

[3] The variable $\widehat{l}(x,j)$ is restricted to take values in the interval $[0,1]$

4.2 Analysis of different level of transfers.[4]

Before proceeding with the analysis of the optimal NIT, I calculate different levels of transfers in order to assess their impact in the steady state equilibrium. The first aspect to point out is that an increase in the transfer level implies a decrease in the GDP per capita.

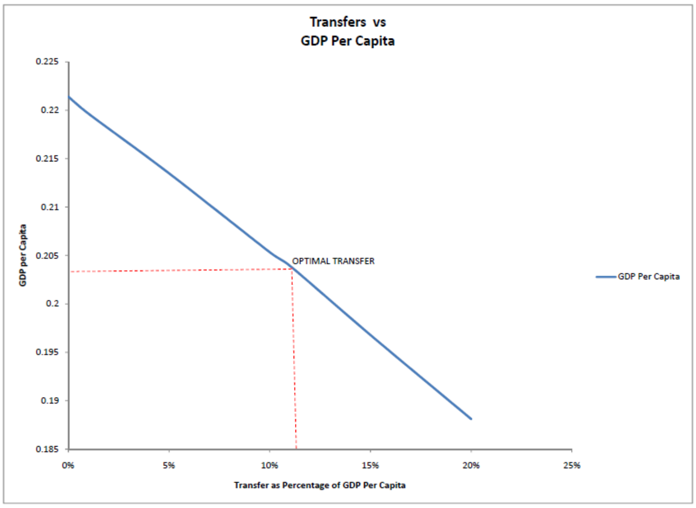


Figure 1: Transfer vs GDP per capita

Table 3 shows that level of GDP Per Capita in a Proportional Tax with no transfers is 0.221, which is 27% higher than the GDP Per Capita in the Actual Income Tax. In the cases of a 1% and 5% transfers, the GDP Per Capita is 0.219 and 0.213 respectively. If I extend the transfer to 20%, the GDP Per Capita is 0.188, which is still 8% higher than the baseline case but 15% lower than the Proportional Tax scenario. The reason lies in the fact that NIT affects labor supply and capital accumulation decisions.

The sole elimination of the tax progressivity induces all agents to work more hours. Labor supply in efficiency units increases to 0.385 from 0.307 and hours worked from 0.264 to 0.34. The increase in both variables is not

[4] Annual figures are expressed in parenthesis. Model periods comparisons are written in the main text.

Variables	**Baseline**	0% TR	1% TR	5% TR
GDP per capita	0.174	0.221	0.219	0.213
K/Y	0.54	0.547	0.541	0.519
Pre-Tax Wage	0.448	0.456	0.453	0.442
Pre-Tax Interest Rate	0.419	0.4	0.408	0.434
Labor supply	0.307	0.385	0.384	0.382
Hours	0.264	0.34	0.339	0.338
Marginal tax rate	-	6.49%	7.69%	12.44%
Growth Consumption	0%	29.18%	28.53%	26.26%
CEV	0%	7%	7.27%	8.21%

Table 3: Steady State Comparison of differentTransfers (model periods)

similar. Labor supply increases by a 25%, while hours worked increase by 29%. Therefore, low productivity agents start working more hours as their tax liability has increased with the reform and they need to accumulate assets for their retirement. Aggregate savings over output grows to 22.88% from 22.21%. Hence, there is a positive impact on capital accumulation. The ratio of capital over output has changed to 0.547 (2.735 annually) from 0.54 (2.7 annually). Also, capital per labor increases 4.9%: Wages are 1.8% higher and the pre-tax interest rate is lower by 4.5%.

Highly productive agents are facing a lower tax rate and all their income is taxed at 6.49%. Their consumption is higher with respect to the Income Tax Scenario and they decide to postpone leisure to older ages. Growth in total consumption is 29.18% (5.25% per year). They consume more at the expense of the low productivity agents, whose share in total consumption has declined.

This Proportional Tax Reform implies a welfare gain of a 7% (1.4% per year) increase in individual consumption. Keeping fixed leisure to previous levels, the welfare gain is 27% (4.9% per year). Not only is consumption higher because of the increase in resources in the economy, but also the distribution of consumption has improved on average; see Table 4.

Naturally, low productivity agents are facing higher taxes and consuming less in relative terms. Their situation is different from the average. They do not favor the new tax system as it means in the case of type 1 agents (lowest productivity) a decrease in their individual consumption of 5.3% (1.1% per year). Interesting enough, the second lowest productive agents (type 2) incurs in a mere loss of 0.17% (0.03% annually). Even though the new distribution does not fit them well, they benefit from the growth in the level of aggregate resources. Type 2 agents are more productive than type 1 agents. Hence, the new hours supply to the market is taxed at a lower marginal rate than the one present in the Income Tax.

The previous gain in consumption is reduced by the fact that agents work more hours. The CEV for leisure is explicit: the jump from the optimal consumption allocation with the initial leisure (c^*, l_0) to the new optimal allocation of consumption and leisure (c^*, l^*) represents a decline in individual consumption of 15.78% (3.4% per year). It is clear that all agents work more hours but the distribution in hours is uniform across all agents' types. Hence, the distribution of leisure has improved. The CEV for leisure acknowledges a decrease of 22.79% (5.04% annually) in individual consumption because of a level effect but an improvement of 9.1% (1.8% annually) because of distribution. Nevertheless, the change in distribution is not strong enough to improve the Total CEV for leisure.

Increasing the level of transfers has a negative effect on GDP per capita, capital accumulation, and consumption growth. A Transfer reduces the level of aggregate savings in the economy. Low type agents save less while the effect is modest in highly productive agents. Hence, the share of total consumption of low type agents increases but consumption growth declines to 26.26% in the 5% Transfer Case from 29.18% in the 0% Transfer Case.

As a result, total amount of resources in the economy diminishes but the distribution improves. The CEV for consumption increases with every transfer but the main drive of the increase is given by the new distribution of resources among all agents' types. Table 4 shows that the Level CEV for consumption decreases 17.91% from the Proportional Tax with no Transfer to the Tax with a 5% Transfer, while the Distributional CEV for consumption increases by 32.36%.

Measures	0% TR	1% TR	5% TR
CEV Consumption	**27.05%**	**27.27%**	**28.13%**
Level	14.52%	13.94%	11.92%
Distribution	10.94%	11.69%	14.48%
CEV Leisure	**−15.78%**	**−15.71%**	**−15.55%**
Level	−22.79%	−22.62%	−22.11%
Distribution	9.07%	8.93%	8.43%

Table 4: Decomposition of Welfare (model periods)

Labor supply and hours devoted to work declines modestly. Nevertheless, the decline is higher for hours than labor supply which means that highly productive agents are working more than low productive agents.

The CEV for leisure improves with the transfers but it is still negative. Agents work more hours with a NIT rather than with the Income Tax. The improvement comes from the Level and not from the Distribution of Leisure.

Naturally, the tax rate increases with the level of transfers. For a 1% and 5% Transfer, the tax rate is 7.69% and 12.44% respectively. This explains that agents are consuming more leisure as it has become cheap.

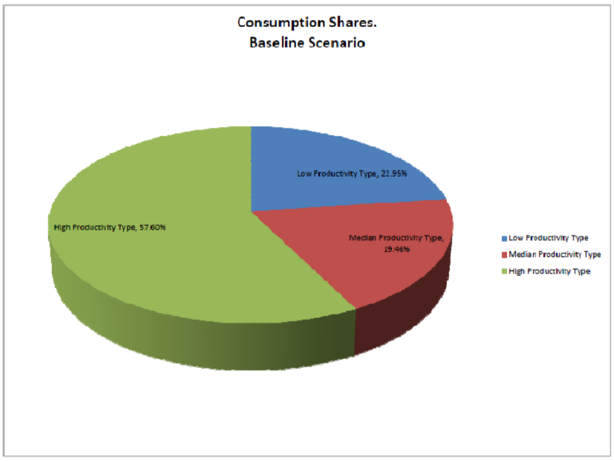
The 1% Transfer is favored by all agents except by type 1 agents who still see the reform as a decline in welfare of 3.9% (0.79% per year). However, a 5% Transfer benefits all agents.

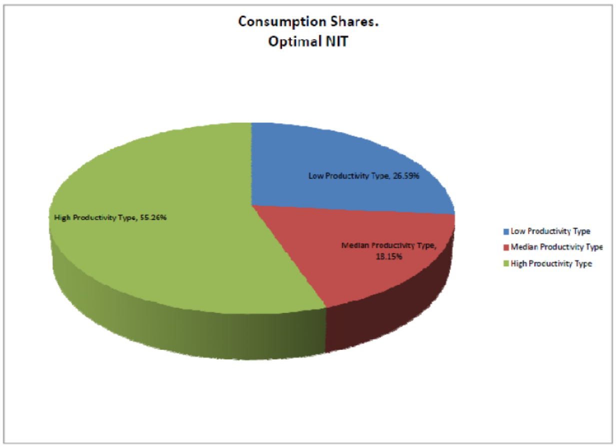
Capital per labor declines with each transfer. Even though labor supply and capital are declining, the latter declines at higher pace. The natural consequence is a decline in wages and an increase in the interest rates.

4.3 Optimal NIT

The optimal NIT has a transfer of 11.02% of the GDP per Capita and a tax rate of 19.51%. This stationary equilibrium has a GDP which is 17.52% higher than the Baseline Scenario, but, as it was depicted above, 4.5% lower than the 5% Transfer case. Labor supply, hours worked and consumption show an increase of 23.57%, 26.67% and 22.48% respectively with respect the Income Tax.

Labor supply and hours decrease at the same rate from the previous transfer of 5%. The share of consumption of the low productive agents increases 16%, from 22.95% to 26.59%, at the expense of the median and highly productive agents; see Consumption Share Chart.





Consumption Shares

The welfare gain is an increase of 8.76% (1.7% annually) of the individual consumption from the baseline case. The main drive in the improvement is the better allocation of resources among agents. This can be seen in the Consumption CEV and Leisure CEV. The only exception is type 1(lowest

Change in Variables	**Optimal NIT. 11.02% TR**
GDP per capita	17.52%
K/Y	−10.22%
Labor supply	23.57%
Hours	26.67%
Consumption	22.48%
Marginal tax rate	19.51%
CEV	8.76%

Table 5: Change in variables: Optimal NIT vs Baseline case

Measures in percent	*Type* 1	*Type* 2	*Type* 3	*Type* 4	*Type* 5	*Type* 6	*Type* 7
Total CEV	8.36	7.27	12.52	10.91	4.82	8.11	4.09
CEV Consumption	16.65	28.71	54.91	22.75	19.1	34.23	20.67
Level	22.48	10.01	−2.77	11.07	10.17	0.27	14.42
Distribution	−4.76	16.99	59.31	10.51	8.1	33.87	5.47
CEV Leisure	−7.11	−16.65	−27.36	−9.65	−11.98	−19.46	−13.74
Level	−22.61	−18.49	−13.39	−28.57	−22.17	−17.91	−19.61
Distribution	20.04	2.26	−16.13	26.49	13.09	−1.89	7.31

Table 6: Decomposition of Welfare by Productivity Types (model periods).

productivity), type 5 and type 7 (highest productivity) agents who see their Consumption CEV improved by the level of the aggregate variables rather than the distribution. It is clear that highly productive agents (type 5, 6 and 7) prefer a lower transfer. The 11.02% transfer has notably improved type 1 and type 2's situation. Type 1 and Type 2's Total CEV has jumped from 1.3% (0.26% annually) and 3.6% (0.71% annually) to 8.4% (1.6% annually) and 7.2% (1.4% annually) respectively.

Life-cycle Profiles: What refers about taxes, the reform clearly benefits highly and median productive agents. The taxes paid follow the pattern of the efficiency profile, increasing the tax liabilities when agents are more productive. All agents pay taxes when they are working and the net transfer is positive for all agents when they are retired. Therefore, the transfer seems to act in the same lines as a Social Security benefit. The system is progressive and agents with higher productivity and, consequently, with higher income pay more. Median agents face more distortions than the other types as it is clear that they are positioned in the kinks of the income brackets. Therefore, the sole removal of the progressivity of the income tax helps them improve their situation.

Regarding average asset accumulation, the upper left panel of Figure 2 shows that the highest productive agents increase their asset holdings. The removal of the high marginal rates that they faced in the Income Tax increases the return of their asset holdings and their labor income. They are able to accumulate more assets. The gap between the benchmark case and the optimal NIT widens in the ages they are more productive. Also, low productive agents increase their asset holdings. However, the story is different for median agents. As they face more distortions, their asset accumulation is not smooth in the benchmark. The removal of these distortions helps them accumulate assets smoothly. Their average asset holdings decline.

Figure 2: Life-cycle Profiles

The upper right panel shows average consumption. The reform increases consumption for all types and all ages. There is a pike in the retirement age that is the result of the non-separability of consumption and leisure. The median agent manages to smooth consumption with the tax reform.

Finally, the lower left panel shows hours worked. All agents work more hours because of the reform. The amount of time devoted to work declines with the years. It is kept at a flat level during the more productive ages and then, declines. Once again, the median agent manages to supply their unit of time smoothly thanks to the reform. It is clear that median agents are the ones who are more affected by the distortions of the Income Tax.

5 Conclusions

In this paper, I characterize an optimal revenue neutral reform from the Actual Income Tax to a Negative Income Tax. I find that the optimal tax rate is 19.51% with a transfer of 11.02% of the GDP per capita. There is an ex-ante welfare gain of a 1.7% annually increase in the individual consumption. Interesting enough, the increase in transfers needed to improve welfare is substantial, i.e. an increase in the transfer from 5% to 11% implies an increase in welfare of 6.7%. All agents favor the reform. Net transfers are positive for all agents once they are retired. Therefore, the transfer seems to behave as a Social Security benefit for the elders.

Consumption, hours worked and labor supply all increase from the baseline case. The absence of differential marginal rates makes all agents supply more hours of work and the labor supply declines with the agent's age. The median agent suffers the most the distortions of the Income Tax. A constant tax rate enables her to smooth asset accumulation and leisure.

An increase in the size of the transfer decreases the GDP per capita. However, in the extreme case of a 20% transfer, GDP per capita is 4% higher than the baseline case. Labor supply and hours worked diminish with the level of the transfer but at a different rate. Consequently, there is a change in the composition of the labor supply measured in efficiency units: highly productive agents gain participation at the expense of the low productivity type agents.

The approach considered has the strength to set the introduction of a Negative Income Tax in a general equilibrium specification. Even though, I have not considered more sophisticated idiosyncratic shocks, the reform seems plausible and the welfare gains present in this setting encourage further research on the subject. The introduction of idiosyncratic shocks, the study of the transitions from one system to the other one and the incorporation of an effective tax function are aspects to be considered in a future paper.

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