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Isabel Correia

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Please address correspondence to Isabel Correia, Economic Research Department, Banco de Portugal, Av. Almirante Reis no. 71, 1150-012 Lisboa, Portugal;
Tel: 351-21-3128385 Fax: 351-21-213107805; email: mihcarvalho@bportugal.pt.

Consumption Taxes and Redistribution

Isabel Correia*

Banco de Portugal, Universidade Católica Portuguesa and CEPR

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Abstract

It is relatively well known that the introduction of consumption taxation as an alternative in the tax code, and as the main source of government revenues, leads to a more efficient tax system.

However the conventional wisdom is that the change from the actual tax code, based on taxation of capital and labor income to this consumption based system, has undesirable distributional consequences. In this work a very simple method is developed to argue that the converse is the most reasonable outcome from that fundamental tax reform. The main difference in relation to the literature comes from the assumed source of household heterogeneity. Additionally it is shown that the inclusion of a tax on consumption allows for redistributive policies with no costs in terms of efficiency.(JEL: D63, E62, H20)

1. Introduction

Although tax reforms are a recurrent phenomena in every developed economy for the last decades, most tax codes are characterized by extremely complex rules mainly around business taxes and personal taxation of income. The high costs involved with such systems motivated concerns from politicians and academics,

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leading to a broad discussion on the advantages of a fundamental tax reform. One goal of such reform would be to simplify the existing systems. There has been some consensus on the adoption of a system that favors a flat tax¹. The most commonly expressed objection to this radical reform proposal concerns its distributional consequences. A representative quote is Robert McIntyre, from 'Citizens for Tax Justice': "there is little or no disagreement among serious analysts that replacing the current, progressive income tax with a flat tax would dramatically shift the burden of taxation from the wealthy- and onto the middle class and the poor" (see Slemrod and Bakija (1996)).

The objective of this paper is to discuss the effects on equity of a change from the existing tax systems, based on capital and labor taxation, to a system based on consumption taxation. We want to stress the distributional effects of the reform of taxation across agents with different levels of welfare.

There are some very detailed studies of the impact of this type of reform for the U.S. economy. Examples are Gentry and Hubbard (1997) and Feenberg, Mitrusi and Poterba (1997). These works compute the distribution of tax burdens under alternative tax regimes, using very sophisticated data bases on household portfolio composition, the first one, and on consumption, income and tax liabilities, the second. Although these studies have a very detailed description of household position they do not include the general equilibrium effects of the tax reform. Tax burdens are equivalent to tax liabilities for different income and consumption groups. A different approach in the literature take into account the general equilibrium effects of the reform. The emphasis is on the intergenerational effects of the reform. Two exceptions are Fullerton and Rogers (1996) and Jorgenson and Wilcoxon (1997) which allow for different income levels within each generation. Both are limited to the long run effects and conclude for the regressivity of the reform. Examples of work that compute the whole transition path are Altig et al (2001), that impose an exogenous amount of debt over time across reforms, being its main contribution the formalization of intragenerational heterogeneity in a dynamic life cycle model and the specific calibration for the U.S. tax code. The other example is Ventura (1999) that compares distributions by income and wealth and not by welfare. Both studies consider the main cause of heterogeneity being exogenously given labor efficiency. Other studies, like Krusell et al (1996), make an exercise similar with the last part of this paper: taxes are used to finance transfers but there transfers are endogenous. That study use a political-equilibrium theory and conclude that the median voter can be worse-off and that "a change from

¹Hall and Rabushka (1995) it is perhaps the most well known proposal of a flat tax system.

income to consumption taxes may make everybody worse off".

This study focuses on the whole effect, transition plus steady state, when the general equilibrium effects are clearly taken into account. And the main question raised is the effects on equity of the introduction on the tax system of a consumption tax. The main results derive from the comparison of lifetime welfare distributions associated with several different compositions of fiscal instruments. We differentiate from Altig et al (2001) on building a much simpler structure. In that way we get a clearer understanding of the main channels through which a change in taxation affect welfare distribution and of the importance for the results of the type of exogenous heterogeneity imposed across agents. In addition the results are robust to very different distributions of the exogenous heterogeneity. In a first step we compare the welfare distribution when a system characterized by taxing capital and labor at different rates is substituted by a regime that does not tax capital. The financing of public expenditures results at this stage from a flat tax on consumption and on labor income. We show that, if the share that is financed by the consumption tax is high enough, and clearly when the only tax is the consumption tax, equity improves relatively to the initial system. These results are computed using a general equilibrium model that replicates the usual long run characteristics of the U.S. economy. The method used to compute the effects on equity is very parsimonious in terms of cross section information. To replicate the main characteristics of US cross section data (see Diaz-Gimenez et al (2002)) heterogeneity comes from asymmetries on wealth and on labor efficiency, and wealth distribution is more concentrated than earnings. These mild assumptions are enough to allow us to get the result that a reform that eliminates the tax on every type of income and finances public expenditures exclusively with consumption taxation, improves equity and increases always the welfare of those households that are worse off than the average of the population. In a second step we show, for the same assumptions on heterogeneity, the effects of introducing deductions on the tax code. These deductions work like lump-sum transfers because we impose that they are not differentiated across households. We show that we can use the tax on consumption and the tax on labor income to finance these transfers in a way that efficiency is maintained and equity improves monotonously with the amount transferred to every household. Then the main result of this work is that the a tax reform which introduces consumption taxation together with an anonymous deduction can improve equity and efficiency and can therefore guarantee that at least the welfare of households with welfare lower than the average of the economy will be better off with that reform.

The paper is organized in the following way: in the next section we develop analytically some equivalence results for different tax codes. These equivalences allows us to present some results on efficiency and to conjecture on the effects that the tax on consumption can have on equity. Section 3 derives the effects on distribution of the change to a flat tax on consumption. In the first part the effects on equity of financing public expenditures predominantly with a tax on consumption are derived with a numerical model. The effects on equity of introducing lump-sum and uniform transfers financed with consumption taxation are derived afterwards analytically. Section 4 concludes.

2. Equivalence Results

In this section we develop the intuition that the advantage of a fiscal code that includes a tax on consumption comes from the fact that with this tax it is possible to replicate equilibria identical to the one where the government could differentiate across agents, in a non distortionary way. The possibility of introducing a tax on consumption on the tax code has a known advantage due to its positive impact on efficiency. That is, the tax burden of financing a given path of government expenditures is reduced when compared to the one based on income taxation. In this section, and using an equivalence result, we explain this result in a very simple way. Using this equivalence result we can make the conjecture that by giving a bigger role to consumption taxation in tax codes we can aim at a more equitable system, simultaneously with a more efficient one.

Our set up is one of a non-monetary deterministic economy where markets are competitive². For simplicity we will suppose that the only distortion that exists in this economy comes from the fact that public consumption, which is exogenous, has to be financed with distortionary taxation, or with lump-sum taxes which cannot discriminate across households. Preferences are identical across households, indexed by i , and defined over a sequence of aggregate consumption goods, $\{C_{it}\}_{t=0}^{\infty}$, and over a sequence of hours of work, $\{N_{it}\}_{t=0}^{\infty}$. Diversity across agents in the economy results from different initial assets holdings, i.e. wealth that can be accumulated, mainly physical capital and bonds³, as well as from different

²These constraints on the environment are irrelevant for the results. That monetary economies, nominal rigidities and market imperfections are irrelevant for this result is proved in Correia, Nicolini and Teles (2004).

³We could also have human capital as an asset that could be chosen after period zero. This would imply that the technology would depend on human capital. For simplicity we consider

labor efficiency levels which are exogenous to agents decisions. Households are price takers and anonymous in the markets, which implies that every individual faces identical prices. Government has no information about the characteristics that differentiate agents so it treats every agent also anonymously, that is the tax rates on capital income, labor income and consumption, and the amount of transfers (when these are introduced) are identical across households. The exercises that are performed in this work compare fiscal policies that are invariant over time, i.e. tax rates and transfers are constant over time.

Then the intertemporal budget constraint for agent i can be written as:

$$\sum_{t=0}^{\infty} d_t(1 + \tau_c)C_{it} = \sum_{t=0}^{\infty} d_t [(1 - \tau_n)w_tE_iN_{it} + Tr] + (1 + r_o)A_{io} \quad (2.1)$$

where d, w, τ_c, τ_n, Tr , and r_o represent, respectively the discount factor (net of the tax on capital) and the gross real wage at period t , the tax rate on consumption, the tax rate on labor income, the amount of transfers from the government, and the net real return on initial wealth. E_i and A_{io} represent the exogenous factors that differentiate agents in this economy. E_i is the labor efficiency level of agent i and A_{io} represents the initial level of non-human wealth of agent i , that is, the endowment that, together with E_i , differentiates agents in this economy. Prices, $p = \{d_t, w_t, \tau_c, \tau_n\}_{t=0}^{\infty}$ and r_o , and transfers are exogenous to the individual household. The anonymity of households implies that the government is not able to raise revenue (or make transfers) designed for a special individual i . Discriminatory lump-sum taxes and transfers are therefore excluded from the tax code.

The results of this section are developed by the construction of a tax system equivalent to another one that includes a tax on consumption. The first system, which is used just for derivation of results given its tractability, includes a levy on initial wealth. Let us call this virtual discriminatory levy L . This tax applied on initial wealth implies that every agent pays a discriminatory lump-sum tax equal to $L(1 + r_o)A_{io}$.

We begin by showing the equivalence that exists between this discriminatory lump-sum tax and the tax on consumption.

Definition 1: Two tax codes with different tax instruments are equivalent when they decentralize the same equilibrium (aggregate and individual allocations and prices gross of taxes).

that just raw non-accumulated labor and physical capital are productive.

We differentiate tax codes by its instruments. Tax code f is a vector which elements are ordered as follows: the tax rate on consumption, the tax rate on labor income, the tax rate on capital income, the annual per capita transfer and the initial levy.

Lemma 1: The tax code $f^A = (\tau_c^A, \tau_n^A, \tau_K^A, Tr^A, 0)$ is equivalent to the virtual⁴ fiscal policy $f^B = (\tau_c^B, \tau_n^B, \tau_K^B, Tr^B, L)$, where $(1 + \tau_c^B) = \frac{(1 + \tau_c^A)}{\Phi}$, $(1 - \tau_n^B) = \frac{(1 - \tau_n^A)}{\Phi}$, $\tau_K^B = \tau_K^A$, $Tr^B = \frac{Tr^A}{\Phi}$, and $1 - L = \frac{1}{\Phi}$, where $\Phi > 1$.

Proof. Policy f^A is characterized by a higher tax on consumption than policy f^B . The budget constraint for agent i associated with policy f^A is:

$$\sum_{t=0}^{\infty} d_t(1 + \tau_c^A)C_{it} = \sum_{t=0}^{\infty} d_t((1 - \tau_n^A)w_t E_i N_{it} + Tr^A) + (1 + r_o)A_{io} \quad (2.2)$$

Dividing by Φ the budget constraint for this individual i can be written as

$$\sum_{t=0}^{\infty} d_t(1 + \tau_c^B)C_{it} = \sum_{t=0}^{\infty} d_t((1 - \tau_n^B)w_t E_i N_{it} + Tr^B) + (1 + r_o)(1 - L)A_{io} \quad (2.3)$$

Individual first order conditions are identical under policy f^A or f^B . For the same resources constraint, including the same path of government expenditures, equilibrium prices gross of taxes should be identical in both cases. Aggregate and individual allocations are also identical and the two policies are therefore equivalent. ■

In this work we impose that, although households differ, the economy is still amenable to Gorman aggregation⁵. A representative household, $i = r$, can be defined which determines the aggregate equilibrium allocations and prices, independently on the individual distribution of characteristics and therefore independently of individual allocations and welfare. Labor efficiency is normalized such that w represents the wage rate of the representative agent, that is $E_r = 1$.

⁴Virtual because it includes the discriminatory tax that cannot be available in the potential code.

⁵The conditions for the existence of this representative agent are related in part with conditions already imposed and in part with the choice of parameters of preferences that we do in section 3. Until now we imposed the anonymity of agents in the market and for the government. This assumption leads to net prices identical across agents that is a necessary condition for Gorman aggregation.

Definition 2: Efficiency is measured by the welfare of the representative household. Namely a change of policy leads to an increase of efficiency when the welfare of the representative agent is higher in the equilibrium associated with the second policy.

We can write a corollary of lemma 1 that states the very strong result that the inclusion of a tax rate on consumption can eliminate any distortions in the financing of public consumption:

Corollary (Coleman (2000)): A policy that taxes consumption and subsidizes labor at the same rate, i. e. the policy $f = (\tau, -\tau, 0, 0, 0)$, with τ such that the intertemporal government budget is satisfied, leads to a first best equilibrium.⁶

Proof. Using lemma 1 this policy is equivalent to the virtual policy $f^V = (0, 0, 0, 0, L)$, that is to a policy that finances public expenditures only with taxes that are equivalent to a lump sum tax. Since it implies no distortions the economy achieves the first best. ■

This policy recommendation was abandoned for long in the literature because in static models it delivers zero revenues. However it has a completely new role in dynamic models with capital, as the one we study here. However, as Coleman (2000) notes, the policy recommendation that labor should be subsidized it is difficult to implement due to high (perhaps infinite) costs of verification of hours of work. When the restriction that labor income taxes cannot be negative is imposed, this restriction is active and the first best is no longer achievable. We therefore compare in efficiency terms a sequence of policies where taxes on consumption are increasing and labor taxes cannot be negative.

Proposition 1: The increase of the tax on consumption to finance an exogenous stream of government expenditures, when the alternative tax is a non negative tax on labor income, leads always to an increase in efficiency.

Proof. Let us suppose that the tax on capital as well as transfers, τ_K and Tr , are zero and that the government budget is financed with a constant tax on consumption (τ_c^1) and a constant tax on labor income, (τ_n^1). This tax policy is to be compared with another one where the budget is financed with a higher tax on consumption, ($\tau_c^2 > \tau_c^1$), and with a lower tax on labor income ($\tau_n^1 > \tau_n^2$).

Using lemma 1, policy 1, $f^1 = (\tau_c^1, \tau_n^1, 0, 0)$, is equivalent to the virtual policy $f^{1V} = (0, \tau_n^{1V}, 0, 0, L^1)$, and policy 2, $f^2 = (\tau_c^2, \tau_n^2, 0, 0)$, is equivalent to the virtual policy $f^{2V} = (0, \tau_n^{2V}, 0, 0, L^2)$. As $\tau_c^2 > \tau_c^1$ then $L^2 > L^1$. Since we impose that $\tau_n^1, \tau_n^2 \geq 0$, policy 2 is more efficient than policy 1, because public consumption is

⁶See Coleman (2000) for a different proof of this result.

financed with a lower distortionary tax.⁷ ■

Corollary: If we restrict the tax rate on labor income to be non negative the most efficient policy is to tax exclusively consumption, that is $f = (\tau_c, 0, 0, 0)$ ⁸. ■

The idea of this paper is to use the equivalence result of lemma 1 for comparing policies with different taxes on consumption (and labor income), by its distributive effects. As shown in Proposition 1 a change that increases the tax on consumption and decreases the tax on labor is equivalent to a change that taxes labor income at a lower rate and at a higher rate initial assets. When the main heterogeneity across households is initial wealth, it is natural to conjecture that this increase of the tax rate on consumption lead to a more equitable solution. As we just showed that change of policy increases efficiency. We can also conjecture that it will increase the welfare of households located to the left of the distribution, that is those whose welfare is lower than the average. Nevertheless, as distributional effects also depend on the effects on equilibrium prices of the change in policy, that conjecture has to be carefully tested using a complete general equilibrium model. This is the subject of next section.

3. Increasing the tax on consumption

The conjecture that a substitution of the consumption tax for the existing system, based on capital and labor income tax, improves equity will be tested in a general equilibrium model with heterogenous agents. We have already showed that, if capital taxation was zero, the elimination of the tax on labor income and its substitution by a tax on consumption increases efficiency. We consider that the initial system finances an exogenous stream of public consumption with a tax on capital and a tax on labor income. One of the abstractions from the existing systems is that although the tax on capital income differs from the tax on labor income we impose a unique tax of either type. We also consider that the system does not use transfers (lump sum transfers) or deductions. After showing the results of moving

⁷The intuition of the result is very similar to the one in Helpman and Sadka (1982). There the lump sum taxation is obtained through the implicit taxation of profits given the decreasing returns to scale technology.

⁸In this case, where the tax code imposes non negative taxes on labor, the optimal constant tax on capital is in theory positive such that the initial levy can be used to reduce the distortions of the system. Nevertheless, quantitatively, this optimal tax rate is approximately zero (see Coleman (2000)). Coleman also shows that the decline in efficiency due to the imposition of a non negative tax on labor is small, mainly when compared with the gain of introducing the tax on consumption.

to codes that use just a consumption tax, we introduce transfers (or deductions) and analyze their role, when its financing is performed with consumption taxes. As we said before the set up is such that the aggregate equilibrium can be replicated by the representative household paradigm. We describe below how we can take advantage of these assumption to understand the effects on equity, that is on welfare distribution.

3.1. The model

The economy is described by a set of heterogeneous households with infinite life indexed by $i = 1, \dots, I$. The preferences of every household can be described by the general lifetime utility⁹:

$$U_i = \sum_{t=0}^{\infty} \beta^t \frac{(C_{it} - \chi N_{it}^{\varphi})^{1-\sigma}}{1-\sigma}, \sigma > 0, \chi > 0, \varphi > 1 \quad (3.1)$$

where C_i and N_i represent respectively agent i choices for consumption and work hours.

Each household maximizes the utility function (3.1), subject to the budget constraint, represented by equation (2.2).

This class of utility functions is not homothetic in C and N . However it is quasi-homothetic in consumption, as we proceed to show. The households optimal decision can be solved in two stages: In a first stage, the number of hours of work in each period is computed. The equalization of the intratemporal rate of substitution and the real wage rate leads to the determination of the choice of hours of work by agent i :

$$N_{it} = \left[\frac{(1 - \tau_n)w_t E_i}{\chi \varphi (1 + \tau_c)} \right]^{\frac{1}{\varphi-1}}$$

This first order condition reflects the fact that, for this class of preferences, there are no wealth effects on labor supply. Labor supply, in a given period, depends

⁹To guarantee aggregation, it is necessary to impose that either the momentary utility function is homogeneous in $C_{it} - \bar{C}_t$ and $1 - N_{it}$, or is additive and linear in at least one argument. We chose to use the class of utility functions proposed by Greenwood, Hercowitz and Huffman (1988), since, in opposition to the isoelastic representation, it allows the replication of cross section data. For a discussion see Correia (1999c). Nevertheless, the qualitative results are not affected by the choice of this functional form for preferences.

exclusively on the net wage rate and the tax rate on consumption. Since the households face identical prices this implies that labor choices by poor and rich households coincide, for identical values of the efficiency level, E_i . In this case poor and rich agents are differentiated exclusively by their consumption decisions. If rich agents have higher labor efficiency levels they choose to work more hours than poor agents do. In any case the decision rules on hours of work are either identical across agents or linear in $E_i^{\frac{1}{\varphi-1}}$, and therefore can be aggregated for the whole economy.

In a second stage, the number of work hours is replaced in the utility function by the supply of labor, and the problem of optimal consumption is solved for a Stone-Geary type momentary utility function,

$$U_i = \sum_{t=0}^{\infty} \beta^t \frac{(C_{it} - \bar{C}_{it})^{1-\sigma}}{1-\sigma},$$

$$\text{where } \bar{C}_{it} = \chi \left[\frac{(1-\tau_n)w_t E_i}{\chi\varphi(1+\tau_c)} \right]^{\frac{\varphi}{\varphi-1}} \quad (3.2)$$

This representation of preferences, homogeneous in $(C_{it} - \bar{C}_{it})$, shows that the original preferences are quasi-homothetic in consumption. The budget constraint, (2.2), after replacing N_{it} for its optimal value, can be rewritten as:

$$\sum_{t=0}^{\infty} d_t (1 + \tau_c) (C_{it} - \bar{C}_{it}) = \sum_{t=0}^{\infty} d_t \left[\frac{((1 - \tau_n)w_t E_i)^{\frac{\varphi}{\varphi-1}}}{((1 + \tau_c)\chi\varphi)^{\frac{1}{\varphi-1}}} \left(1 - \frac{1}{\varphi}\right) + Tr \right] + (1 + r_o)A_{io} \quad (3.3)$$

Using this budget constraint, and the first order condition:

$$\frac{C_{it+1} - \bar{C}_{it+1}}{C_{it} - \bar{C}_{it}} = \left[\beta \frac{d_t}{d_{t+1}} \right]^{\frac{1}{\sigma}},$$

the optimal decision rules of $C_{it} - \bar{C}_{it}$ can be computed for $t = 0, \dots, \infty$. It is straightforward to show that consumption decision rules are, for every agent and time period, affine in $E_i^{\frac{\varphi}{\varphi-1}}$ and in A_{io} .

It is well known that the advantage of assuming aggregation comes from the fact that the aggregate equilibrium of this economy, and therefore the equilibrium prices, can be obtained without keeping track of the individual optimal decisions. For the representative agent ($i = r$) optimal rules are identical to the ones derived for agent i , when

$$E_r^c \equiv \left(\frac{\sum_{i=1}^I E_i^{\frac{\varphi}{\varphi-1}}}{I} \right)^{\frac{\varphi-1}{\varphi}}$$

$$E_r^N \equiv \left(\frac{\sum_{i=1}^I E_i^{\frac{1}{\varphi-1}}}{I} \right)^{\varphi-1}$$

$$A_{ro} = \sum_{i=1}^I \frac{A_{io}}{I}$$

E_r^c and E_r^N are defined as the "average" index of the efficiency level relevant respectively for the consumption decisions and for the hours of work decisions.

In order to characterize the aggregate general equilibrium, more information on the set up is necessary. The technology is described by a neoclassical production function $Y_t = F(K_t, N_{rt})$, where K_t represents the average stock of physical capital. There is a constant proportional depreciation rate, δ , and there are no adjustment costs, in capital accumulation. The government is characterized by per capita expenditures, G_t , and tax rates, τ_c, τ_n , and τ_k , respectively, taxes on consumption, labor income and capital income net of depreciation. The taxes are flat and constant over time. Transfers per period are represented by Tr , and initial per capita public debt by B_o^g .

The aggregate equilibrium is defined by a sequence of per capita quantities - C_{rt} , N_{rt} , and K_t and prices, $p_t = \{d_t, w_t\}_{t=0}^\infty$, that satisfy the decision rules of the representative agent together with¹⁰

$$Y_t = F(K_t, N_{rt}) = K_{t+1} - (1 - \delta)K_t + C_{rt} + G_t$$

$$A_{ro} = K_0 + B_o^g$$

$$\begin{aligned} & \sum_{t=0}^\infty d_t(G_t + Tr) + B_o^g = \\ & = \sum_{t=0}^\infty d_t \tau_c C_{rt} + \sum_{t=0}^\infty d_t \tau_n F_{2t} N_{rt} + \sum_{t=0}^\infty d_t \tau_k (F_{1t} - \delta) K_t \end{aligned}$$

$$d_0 = 1$$

$$d_t = \frac{1}{\prod_{s=0}^t (1+r_s)}, \quad t > 0$$

$$r_t = (1 - \tau_k)(F_{1t} - \delta)$$

$$w_t = F_{2t}$$

¹⁰ $F_j(\cdot)$ is the partial derivative of $F(\cdot)$ with respect to the j th argument.

Preferences, technology, initial average wealth and government policy, determine the aggregate general equilibrium, without information on the distribution of initial wealth, A_{io} , or on the distribution of efficiency levels, E_i .¹¹

The effects on equity of the tax reform are measured through the effects of welfare distribution. From the proposed utility function we can express the indirect utility, V_i , as:

$$V_i^{\frac{1}{1-\sigma}} = \frac{\Gamma(p)}{1-\sigma} \left[\sum_{t=0}^{\infty} d_t \left(\frac{((1-\tau_n)w_t E_i)^{\frac{\varphi}{\varphi-1}}}{((1+\tau_c)\chi\varphi)^{\frac{1}{\varphi-1}}} \left(1 - \frac{1}{\varphi}\right) + Tr \right) + (1+r_o)A_{io} \right] \quad (3.4)$$

Note that this indirect utility function is a transformation of an expression that is affine on $E_i^{\frac{\varphi}{\varphi-1}}$ and A_{io} . This property is a direct consequence of the conditions imposed for aggregation, namely that agents face the same prices and the assumed class of preferences, and it will be very important to allow for welfare distributions comparisons in a straightforward way.

3.2. The method¹²

In models amenable to Gorman aggregation, the indirect utility for agent i can be represented by $H(V_i) = v_i = \alpha(p) + \gamma(p)e_i$, where e_i represent the endowments on which agents differ.

In order to compare the indirect utility index between any two households, i and j , the ratio v_i/v_j , is computed. The choice of an affine representation for the indirect utility amounts to saying that the ratio between agent i 's and agent j 's consumption of every good, or consumption of transformed good ($C - \bar{C}$) as in our case, coincides with the ratio of life time utilities. The value of this ratio is the answer to the question: How much would the consumption of agent i have to grow, so that agent j would be indifferent to change its position with agent i ? It is in the sense of using the consumption equivalent criteria, that we can say that interpersonal utility comparisons are free from cardinality.

To rank policies by their distributional effects is to compare the vectors of individual utilities. We compare changes in inequality induced by different policies,

¹¹To calibrate E_r^c and E_r^N it is necessary information on time series average of labor income and hours of work.

¹²This method, that determines the effects of equilibrium changes on distributions, is developed in Correia (1999b).

by ordering the v distributions using the relative differential concept.¹³ Then policy 1 dominates policy 2 if and only if the percentage increase in consumption of a poor agent necessary to equalize his consumption with any richer agent is lower in policy 1 than in policy 2. The individual welfare indicator and the inequality criterion chosen imply that the inequality ranking is, in the sense defended before, free from interpersonal utility comparisons.

In Correia (1999b) it is shown that

$$v^1 \succ_{rd} (\prec_{rd} \text{ or } \approx_{rd}) v^2 \text{ when } \frac{\alpha(p^1)}{\gamma(p^1)} > (< \text{ or } =) \frac{\alpha(p^2)}{\gamma(p^2)} \quad (3.5)$$

when heterogeneity across households can be reduced to one dimension.

The advantage of this method is the possibility to infer qualitative distributional effects of policy reforms, with no explicit knowledge on the distribution of characteristics of agents in the economy. Since in our model economy agents differ by two dimensions we will analyze separately two cases:

Case A: Households differ exclusively by the stock of initial non human wealth.

In this case, $E_i = 1$ and $e_i \equiv A_{io}$.

Then using (3.5) the effect on distribution will be determined in this case by computing the change in the following expression for a given change in the tax policy tax:

$$\frac{\alpha(p)}{\gamma(p)} \equiv \sum_{t=0}^{\infty} \frac{d_t}{1+r_o} \left(\frac{((1-\tau_n)w_t)^{\frac{\varphi}{\varphi-1}}}{((1+\tau_c)\chi\varphi)^{\frac{1}{\varphi-1}}} \left(1 - \frac{1}{\varphi}\right) + Tr \right). \quad (3.6)$$

Case B: Households differ on the stock of accumulated wealth as well as on the labor efficiency index, such that $\frac{E_i^c}{A_{io}} = \frac{E_i^{\frac{\varphi}{1-\varphi}}}{A_{io}} = \frac{1}{A_{ro}}$, i.e., the consumption index of labor efficiency is perfectly correlated with initial non-human wealth across individuals.

¹³ Policy 1 dominates policy 2 in relative differentials, $v^1 \succ_{rd} v^2$, iff

$$\frac{v_i^1}{v_j^1} > \frac{v_i^2}{v_j^2}, \text{ for } i < j$$

For any two distributions, Lorenz dominance implies relative differential dominance and relative differential dominance is equivalent to Lorenz dominance for every partition of the population set.

Using (3.5) to rank policies by inequality the following expression has to be computed for every policy:

$$\frac{\alpha(p)}{\gamma(p)} \equiv \frac{\sum_{t=0}^{\infty} \frac{d_t}{1+r_o} Tr}{1 + \frac{1}{Aro} \sum_{t=0}^{\infty} \frac{d_t}{1+r_o} \frac{((1-\tau_n)w_t)^{\frac{\varphi-1}{\varphi}}}{((1+\tau_c)\chi\varphi)^{\frac{1}{\varphi-1}}} (1 - \frac{1}{\varphi})}.$$

Notice that, in this case, if $Tr = 0$, this ratio is always identical to zero, and it is therefore independent of the policy. An economy characterized by this heterogeneity and by a tax code that does not include transfers, will have no effect on welfare distribution when tax policy changes.

The reason to focus on these two extreme cases is related to the empirical evidence on cross section data. The literature on this question (see e. g. Diaz-Gimenez, Quadrini and Rios-Rull (2002)) concludes that concentration is higher in wealth than in income, and that these two variable are correlated. Therefore heterogeneity should come mainly from potentially accumulated assets and a smaller share to exogenous characteristics of agents. In our characterization the economy distribution should be between cases A and B. This assumption is relevant for the difference between our results and most of the comparable literature.

3.3. The flat consumption tax

In this section we determine the effect on inequality of a sequence of tax reforms in which the importance of the taxation of consumption increases. The final code consists uniquely of a constant and uniform tax on every consumption good. In the whole exercise the level of government expenditures per period is maintained constant. In this sense the exercise is revenue neutral. Here we assume that transfers (or deductions) do not belong to the possible set of fiscal instruments. Most actual tax codes include taxes on capital and on labor income. This status quo policy is simplified in the model by assuming that these taxes are flat and uniform.¹⁴ The first exercise is the substitution of the status quo system by a system that does not rely on taxes on capital. Therefore we begin by eliminating the tax on capital income and by financing the government budget exclusively through a tax on labor income. This new system with no taxes on capital income is then compared with systems where the same sequence of public expenditures

¹⁴The type of heterogeneity stressed in this work, wealth and labor efficiency heterogeneity, and the chosen initial values for the flat tax on capital income and labor income implies that the status quo system has a marginal tax rate that is increasing in income.

is financed with higher taxes on consumption and lower taxes on labor. The last reform is the change to a system where the financing is done exclusively through the taxation of consumption.

The described model is calibrated so that the initial tax code, $\tau_k = .5^{15}$, $\tau_n = .23$, and $\tau_c = 0$ is consistent with $N = .25$ and $G/Y = .19$. Preferences are such the $\varphi = 1.8$, $\chi = 2.34$, $\sigma = 1.001$ and $\beta = .96$. The technology is Cobb Douglas, the share of capital is .4 and depreciation rate is .1. As referred before the annual value of government expenditures derived from this model is maintained in every alternative tax code.

The steady state associated with the initial tax code, $\tau_k = .5$, $\tau_n = .23$ and $\tau_c = 0$, defines the status quo situation of this economy. In the first alternative scenario the taxation on capital income is eliminated and labor is taxed at a constant rate such that the present value of the exogenous government expenditures is equal to the present value of labor tax revenues. The labor tax rate that accommodates that solution is $\tau_n = .35$. In the following scenarios, we allow for an increase of the tax on consumption. The second alternative scenario is characterized by a consumption tax rate .14 and by a tax on labor income of .21. In the third scenario the tax rate on consumption rises to .18 and the tax on labor is reduced to .15. The last scenario is constructed such that the tax rate on labor income is zero and the tax rate of consumption of .29 is able to finance the annual value of government expenditures.

In order to compute these alternative aggregate equilibria it was not necessary to make any assumption on the heterogeneity across agents. The average stock of financial wealth, A_{ro} , is the one consistent with the steady state of the status quo and we assumed that the average efficiency level is 1. The equilibrium trajectory of the economy associated with each one of the alternative tax codes is computed including the transition path to the new steady state. To proceed on the effects on distribution of these alternative policies, assumptions on the heterogeneity have to be made. As stated above when transfers are zero and the different stocks of initial wealth are perfectly correlated with $E_i^{\frac{2}{1-\varphi}}$, case B, changes in policy will have no effects on distribution. Therefore we will report just the effects on (3.6), that is households differ on initial wealth but labor efficiency levels are identical, i.e. $E_i = E_r = 1$, case A.

If agents differ only on financial wealth we can use the numerical solution of this model to compare any two policies by inequality. If the following inequality is satisfied

¹⁵Note that this tax is on capital income net of depreciation.

$$\sum_{t=0}^{\infty} d_t^1 \frac{((1 - \tau_n^1)w_t^1)^{\frac{\varphi}{\varphi-1}}}{(1 + \tau_c^1)^{\frac{1}{\varphi-1}}} > \sum_{t=0}^{\infty} d_t^2 \frac{((1 - \tau_n^2)w_t^2)^{\frac{\varphi}{\varphi-1}}}{(1 + \tau_c^2)^{\frac{1}{\varphi-1}}} \quad (3.7)$$

then $v^1 \succ_{rd} v^2$, and the change from policy 2 to policy 1 reduces inequality.¹⁶

The following table summarizes the numerical results that allow the ranking policies by inequality:

Increasing the tax rate on consumption

Income taxes	status quo $\tau_K = .5$ $\tau_N = .23$	$\tau_N = .35$ $\tau_K = 0$	$\tau_N = .21$ $\tau_K = 0$	$\tau_N = .15$ $\tau_K = 0$	$\tau_N = 0$ $\tau_K = 0$
Consumption taxes	$\tau_c = 0$	$\tau_c = 0$	$\tau_c = .14$	$\tau_c = .18$	$\tau_c = .29$
Distribution effects	3.8	2.9	3.7	4.0	4.8

The last line, distribution effects, reports the value of $\sum_{t=0}^{\infty} d_t \frac{((1-\tau_n)w_t)^{\frac{\varphi}{\varphi-1}}}{(1+\tau_c)^{\frac{1}{\varphi-1}}}$, for each policy. After policy 4, $\tau_N = .15, \tau_K = 0$ and $\tau_c = .18$, the inequality decreases, when compared with the status quo. In this example the substitution of the tax on capital and labor by a tax on consumption increases always efficiency¹⁷, and it reduces inequality when the tax on consumption is relevant in the tax code.

Remember that these effects on inequality occur when the population is differentiated by different initial wealth (case *A*). When the heterogeneity is not only on financial wealth but also on labor efficiency, and these two dimensions are perfectly correlated, there are no effects on distribution (case *B*). In this case for any two policies, we have that, without transfers

$$\frac{v_i}{v_j} = \frac{A_i}{A_j}.$$

¹⁶It is immediate to see that, if agents differ exclusively on labor efficiency, the inequality should have the opposite signal to guarantee the improvement in distribution.

¹⁷The first change in policy, the elimination of the tax on capital income does not always increase efficiency. The chosen numerical example implies an increase of efficiency. The subsequent reforms, increases of the tax on consumption and declining the tax on labor, have always a positive effect on efficiency. (see Proposition 1).

In this case the change of tax codes, and the resulting change of equilibrium prices in the economy, has no effects on the relative differential of any two agents¹⁸. In this case the effect on welfare of every agent is proportional to the one of the representative agent. As the sequence of policies increase always efficiency, the increase of the tax on consumption leads to a Pareto movement.

Using the cross section evidence that allow us to define the case A and B as the two extreme cases that accommodate that evidence, we can summarize the results of this section by saying that the change from a system based on constant taxes on capital and labor income to a system based on a uniform and constant tax rate on consumption, with no transfers, has a positive effect on equity in addition to a positive effect on efficiency. The more the system is based on consumption as the base of taxation, the stronger are the effects on the welfare of the agents that belong to the left part of the welfare distribution. In other words, the *poor* are always better off with the change in policy. The more important is the heterogeneity of the initial wealth relative to the labor efficiency for explaining the existing differences across households, the higher the increase of welfare of these class of agents.

In the extreme case, which we do not consider due to counterfactual cross section properties, agents differ exclusively on labor efficiency and the change to a tax system based exclusively on consumption would increase inequality.

3.4. Consumption taxes with deductions - Redistribution with no losses in efficiency

That a fiscal reform to a consumption tax has a positive effect on equity was the qualitative result derived in the above section. However we could argue that the interest of this result should be quantitative or that it depends heavily from the distribution at the point of departure, or the status quo. The initial system used in the exercise was characterized as one where, although marginal taxes on labor and capital income are constant, the marginal tax on total income is increasing. We know that existing codes have increasing marginal taxes, even if it is often claimed that effective marginal taxes are only slightly increasing. Anyway this fact could have characterized the abstract initial system as less equitable than the actual one. In this section we want to claim that once we allow for deductions on the

¹⁸As stated in Slemrod and Bajika (1996), "the fairness or unfairness of tax changes has become such a divisive issue that ...the issue was...a package of tax provisions that could be characterized as "distributional neutral"". This is the characteristic of the case just described.

tax code we can aim at any¹⁹ "desirable" level of progressivity. We could improve the equitative gains of the reform described in the last section by introducing deductions in the system. This novelty of the consumption tax that we also want to stress in this paper, comes from the fact that when the government can use deductions financed with the consumption tax it is possible to redistribute with no loss in efficiency.

The introduction in the tax code of the possibility to make deductions is equivalent to introduce transfers from the government to every household. Maintaining the discipline of avoiding discriminatory lump-sum transfers we introduce an annual deduction in the tax code, identical across households. Therefore the limit situation, the one where the taxes on labor and capital income are zero, is characterized by a constant transfer (across time and across households) and a constant tax rate on consumption (across time and across goods). This system is characterized by a constant marginal tax but by an increasing average tax and is therefore a progressive system²⁰.

We first show how the introduction of non discriminatory transfers can have no effects on aggregate equilibrium, and therefore efficiency can be maintained. Afterwards the effects of these transfers on equity (or individual equilibrium) are discussed.

Proposition 2: When the tax code includes a tax on consumption, non discriminatory transfers can be increased with no effect on aggregate equilibrium, and therefore different levels of transfers are associated to the same level of efficiency.

Proof. Because conditions for Gorman aggregation are satisfied the aggregate equilibrium is not altered when, for the same path of public consumption, decisions of the representative agent are the same. These decisions are maintained when relative prices are the same and the same decisions satisfy the intertemporal budget constraint of the representative agent. Suppose that the government could use a levy on the initial capital. Then the intertemporal budget constraint can be represented by:

$$\sum_{t=0}^{\infty} d_t(1 + \tau_c)C_{rt} = \sum_{t=0}^{\infty} d_t((1 - \tau_n)w_tN_{rt} + Tr) + (1 + r_o)(1 - L)A_{ro} \quad (3.8)$$

To maintain the aggregate equilibrium increasing L it is necessary that the optimal

¹⁹This desirable level is constrained if we impose a certain level of efficiency, due to the non-negativity of the tax on labor income.

²⁰The advantages of this progressive scheme are discussed in Correia (1999a).

choices of the representative agent are not affected. This is true when the amount of the initial wealth taken by the levy is exactly identical to the additional present value of the transfer given to the representative agent, that is when:

$$(1 + r_o)LA_{ro} = \sum_{t=0}^{\infty} d_t Tr$$

where r_o and $\{d_t\}_{t=0}^{\infty}$ belong to the equilibrium prices for the policy without transfers.

The equivalence results discussed in section 2 allow us to say that when the initial levy is not an available fiscal instrument, the same equilibrium can be attained with :

$$(1 + \tau_c^A) = \frac{(1 + \tau_c)}{1 - L}, \quad (1 - \tau_n^A) = \frac{(1 - \tau_n)}{1 - L} \quad \text{and} \quad \frac{(1 + r_o)LA_{ro}}{1 - L} = \sum_{t=0}^{\infty} d_t Tr^A$$

The change of policy that ensures that these equations are satisfied and therefore the aggregate equilibrium is maintained, as well as efficiency, includes an increase of transfers, an increase of the tax on consumption and a decrease of the tax on labor. ■

We just showed that if the increase of the consumption tax is used to reduce the tax on labor but also to increase transfers the efficiency of the economy can be maintained.

However the described policy, which is neutral in terms of efficiency, has effects on individual decisions and on individual welfare. The increase of the tax on consumption and the decline of the tax on labor income affects different households differently. Also the transfer, although being identical across households, affects the welfare distribution of households. To see this discriminatory effect let us again use the equivalent levy²¹. This levy on initial wealth, L , implies a higher tax on rich individual, with a higher A , since the lump sum paid is given by $(1 + r_o)LA_i$. Because the transfer is the same for every household it is easy to see that households with a higher than average welfare will have a decrease in total net wealth and, on the contrary, households with a level of welfare lower than the average will receive a net positive transfer in present value from the government. As equilibrium prices are maintained these changes in net wealth are the only way

²¹Here the equivalence is on the individual allocation and welfare.

individual's welfare is affected. To determine exactly the effect on inequality we use the method described above.

When the equivalent levy is used, the index of utility for every agent is given by:

$$v_i = \Gamma(p) \left[\sum_{t=0}^{\infty} d_t \left(\frac{((1-\tau_n)w_t E_i)^{\frac{\varphi}{\varphi-1}} (w_t E_i)^{\frac{\varphi}{\varphi-1}}}{((1+\tau_c)\chi\varphi)^{\frac{1}{\varphi-1}}} \left(1 - \frac{1}{\varphi}\right) + Tr \right) + (1+r_o)(1-L)A_{io} \right] \quad (3.9)$$

The effect on equity depends on the type of heterogeneity considered. We will again analyze the two extreme cases and the relative welfare is given by:

Case A :

$$\frac{v_i}{v_j} = \frac{\sum_{t=0}^{\infty} \frac{d_t}{(1+r_o)(1-L)} \left(\frac{((1-\tau_n)w_t)^{\frac{\varphi}{\varphi-1}}}{((1+\tau_c)\chi\varphi)^{\frac{1}{\varphi-1}}} \left(1 - \frac{1}{\varphi}\right) + Tr \right) + A_{io}}{\sum_{t=0}^{\infty} \frac{d_t}{(1+r_o)(1-L)} \left(\frac{((1-\tau_n)w_j)^{\frac{\varphi}{\varphi-1}}}{((1+\tau_c)\chi\varphi)^{\frac{1}{\varphi-1}}} \left(1 - \frac{1}{\varphi}\right) + Tr \right) + A_{jo}}$$

Case B :

$$\frac{v_i}{v_j} = \frac{S + A_{io}}{S + A_{jo}}$$

where

$$S = \frac{\sum_{t=0}^{\infty} d_t Tr}{\sum_{t=0}^{\infty} \frac{((1-\tau_n)w_t)^{\frac{\varphi}{\varphi-1}}}{((1+\tau_c)\chi\varphi)^{\frac{1}{\varphi-1}}} \left(1 - \frac{1}{\varphi}\right) \frac{E_r^{\frac{\varphi}{\varphi-1}}}{A_{ro}} + (1+r_o)(1-L)}$$

It is immediate to see that an increase in L and in Tr leads in both cases to a less unequal welfare distribution. This leads to the following proposition:

Proposition 3: Assuming Gorman aggregation and a tax code that includes a tax on consumption, the increase of non discriminatory transfers such that the efficiency level is maintained implies a more equitable distribution of welfare. Households located at the left of the welfare distribution, *the poor*, will always increase lifetime utility.²²

²²It is easy to verify that even if heterogeneity would come exclusively from labor efficiency this proposition is true.

Concluding, we can say that the possibility of using higher taxes on consumption to finance uniform transfers has the very important characteristic of improving the tax code in terms of equity with no costs in efficiency. A redistribution is possible with no efficiency losses even if the government does not use discriminatory lump-sum taxes or transfers.

4. Conclusions

Fairness is the argument widely used to justify the high complexity of actual tax regimes. The poll tax, that is the simplest tax system, is universally rejected given its unfair characteristics. To avoid the potential complexities of the actual income based regimes, the change to a flat consumption tax is being advocated. In this work it is discussed how the tax burden distribution change if this proposal is implemented. The main conclusion is that the tax burden is more evenly distributed under the simplest and most efficient tax code- the flat tax rate on consumption. This conclusion is in sharp contrast with the one obtained on a year by year base where poor agents have a higher consumption to income ratio than rich agents. The conclusion of this paper is based on heterogeneous agents with infinite lives; that is where bequests are a gift and the donor derives utility from the utility the gift implies for the recipient. This is a strong result because it was derived without any knowledge of the specific distribution of agents in the economy. In this sense our approach is completely complementary with those that construct the so called "distributional tables" which are based on a very special distribution of agents in the economy but do not take into account the general equilibrium effects of policy reforms. These general equilibrium effects are essential in this study to determine the revenue neutral flat rate on consumption and to compute the effect on individual tax burdens measured in utility. The studied distributional effects should be interpreted as the first round effects. The hypothesis of a representative agent implies that the different distributions do not affect equilibrium.

The second conclusion of the paper is that the consumption tax can be used with a tax on the labor income to obtain the desired distribution of the tax burdens with no costs in terms of efficiency: that is, there exists a tax mix that can redistribute without imposing efficiency losses.

These two results mean that a fundamental reform that changes the tax code from the actual one to a new characterized by a constant, across time and goods, marginal tax rate on consumption and by a constant transfer across households will necessarily increase efficiency and equity. This means that the households

poorer than the average would be better off, but also that if there was a direct vote on this reform, since the median is lower than the mean for the distribution of welfare, the result of the majority for the reform. The conclusion repeated on so many studies that the adoption of a consumption base "entails a radical shift in tax burden from the affluent to poor and middle class income families" (see Slemrod and Bakija (1996) page 232) is not a robust statement.

To get this result we use the exogenous heterogeneity suggested by the cross section data and therefore we impose that agents are differentiated by initial assets, that can be accumulated, and by exogenous labor efficiency, that cannot be accumulated, and that these two dimensions of heterogeneity are positively correlated. Our result is strongest in favor of equity that the most benevolent in the literature since they use as the main, or unique, exogenous heterogeneity, labor efficiency. As we showed, this hypothesis in our environment would reverse the results leading to a more unequal distribution, unless a very strong deduction is included.

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