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THE TAX-MIX**

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INEQUALITY, THE POLITICS OF REDISTRIBUTION AND THE TAX-MIX

Jenny De Freitas*

Abstract

Previous research on the political economy of redistribution finds that taxes and redistribution are positively correlated with income inequality. However there is not clear evidence that unequal societies redistribute more. When redistribution is financed through income taxes the existence of an informal sector that evades income taxes reduces the tax-base of the income tax instrument. Inequality may increase the size of the informal sector workforce. Accounting for the tax-base effect of inequality we find a non-linear relationship between inequality and redistribution. We show that the tax-base effect along with the political channel determines the structure of the tax-mix, composed by income and consumption taxes. Moreover we give a rationale for the fact that more unequal societies rely more heavily on indirect taxes.

Key words: Political economy, tax-base effect, inequality, redistribution, informal.

JEL classification: D3, H24.

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1. INTRODUCTION

Developing countries, compared to developed countries, redistribute less and rely more heavily on rather regressive tax instruments as the consumption tax despite being usually more unequal. These observations on the relationship between inequality, redistribution and the tax-mix can hardly be explained following a positive approach. Political competition between office motivated candidates will drive the redistribution level toward the ideal policy of the median income voter (Meltzer and Richard, 1981; Roberts, 1977; Romer, 1975). The greater the gap between pre-tax earnings of the median voter and average earnings (higher inequality), the greater will be the political demand for redistribution (see Persson and Tabellini, 1994). The traditional Downsian model would predict higher inequality to cause higher redistribution. However, previous empirical studies hardly support a positive relationship between redistribution and inequality (Perotti, 1993; Bénabou, 1996; Glaeser, 2006).

Regarding the tax-mix, it is found that developing countries, more unequal than developed countries, rely more heavily on indirect taxes (Tanzi and Zee, (2000); Zolt and Bird, (2005)). As highlighted by Zolt and Bird, (2005) there is a limited role for the income tax instrument in developing countries, where an important percentage of the population works in the informal sector.

The aim of this paper is to highlight the importance of an informal sector to understand why in democracy unequal societies may redistribute less and rely more heavily on tax instruments that are rather regressive as the consumption tax.

Employment in the underground sector or informal sector in developing countries is significantly higher compared to the developed world. For instance, employment in the underground economy ranges from values around 20 percent of total labor force in OECD countries to more than 70

percent in some Asian countries. In India the proportion of the active population in the informal sector (including agriculture) increased from 89 percent in 1978 to 92 percent in 1998. In Latin American countries in 1996 more than 40 percent of the population worked in the informal sector in many countries as Venezuela (42 percent), Colombia (53 percent), Peru (51 percent) and Bolivia (58 percent).¹

We introduce the informal sector as an outside option available to workers. We assume voters can choose between working on a formal sector paying income taxes or working in the informal sector earning a fixed wage and evading income taxes. To model the supply side of informal labor we have to take into account the income tax rates and the wage rates in the formal economy since, higher marginal income tax rates imply a higher supply of informal labor (it reduces disposable income in the formal sector). The informal sector or underground economy tends to be higher in poor countries given that the wage rates are lower there (Loayza (1996); Auriol and Walters (2005)). But we want to disentangle the role of income and inequality determining the size of the informal sector, with this purpose we assume all societies share the same fixed average earnings ability and we rank societies according to second order stochastic dominance (SSD).

The demand for underground labor and supply of underground goods that depends positively on the indirect tax are not modelled here. The cost of the income tax is associated to tax evasion, which decreases the tax-base of the income tax instrument by decreasing disposable income in the formal sector. Indirect taxation has an exogenous and fixed administrative cost.

Previous literature finding a non-linear relationship between inequality and growth or inequality and redistribution (Perotti 1993; Bénabou 2000; Lee and Roemer 1998, 1999) do not take into account the influence of an informal

¹ Data on the OECD countries comes from Scheneider and Enste (2000). The remaining data comes from International Labour Organization (*Key Indicators of the Labor Market*, Table 7).

sector and the tax-mix choice on the level of redistribution, and how this redistribution level changes with inequality. In Lee and Roemer (1999), incomplete credit markets generate a division of the population into two classes: those who privately invest on education and those who don't. The poor support low tax rates since he doesn't benefit from the complementarities between public and private investments in education. They find that public education spending is an inverted U-shaped function of inequality. In our model preferences of the poor and the rich are not align. It is rather a tax-base problem which explains the low redistribution level found in unequal societies.

We will encompass two different effects: the political effect and the tax-base effect, to determine the level of redistribution, the equilibrium tax-mix and the size of the informal sector workforce. We assume earnings ability follows a log-normal distribution and perform numerical simulations to study the shape of the redistribution level and the level of direct and indirect taxes. We find that redistribution may be increasing in inequality for high levels of inequality and high consumption tax administrative costs or for low levels of inequality when indirect tax administrative costs are low. However, for all parameter values considered, we do not find a monotonic relationship between redistribution and inequality. As regards to the tax-mix, the income tax rate is increasing in inequality as long as the median works in the informal sector, capturing the political effect. As a consequence of the tax-base effect the consumption tax rate is higher the lower is its administrative cost and the higher is the informal sector income.

The paper is organized as follows. Section 2 describes the model, in section 3 we determine the set of voters working in the informal sector. Section 4 studies the preferences over tax schedules and characterizes the political and tax-base effects. Section 5 presents the result of the numerical simulation and section 6 concludes.

2. THE MODEL

We model the political competition between two-office motivated parties A and B . Both parties announce a purely redistributive tax schedule and commit to implement the announced tax schedule once in office. The equilibrium concept is majority voting. Voters when casting their ballots evaluate the economic impact of such policies. Once the policy is implemented, voters decide whether or not to participate in the formal sector.

The sequence of choices is as follows: first each party announces the political platform that maximizes his voting share. Then, voters choose between the two parties. The party holding the majority of votes wins the election. When employed in the formal sector voters are differentiated by their earnings ability level, while in the underground sector they face a common income, $n > 0$.

2.1 Preferences

There is a continuum of voters of mass one differentiated by their ability to generate earnings or wage level, w , according to the distribution $F(w)$ with density $f(w) > 0$, for all w . The mean earnings ability level is:

$$\bar{w} = \int_0^{\infty} w dF(w) \quad (1)$$

And the median earnings ability level, m is implicitly determined by

$$\int_0^m dF(w) = \frac{1}{2} \quad (2)$$

We assume w follows a log-normal distribution, the standard deviation of the variable natural logarithm, σ , is our inequality index. All societies share the same average earnings ability, \bar{w} , by assumption. Therefore, we will rank

societies according to second order stochastic dominance (SSD)². So, for $\sigma' > \sigma$, $F_{\sigma'}$ is a mean preserving spread of F_{σ} .

Voters consume a single consumption good, whose price is normalized at one. Voters face an income tax/transfer $T(w)$ and a consumption tax that increases the price of the consumption good, and decide whether to work in the informal sector or not. The population will be divided in two classes: workers in the informal sector who evades income taxes and earn a uniform income of n and workers in the formal sector with pre-tax income, w .

Voters' utility is assumed to be linear in the level of consumption of the good, X . The indirect utility of an informal sector worker is denoted V^n and the utility of a worker in the formal sector is denoted V^w .

2.2 Tax schedule

The Government collects taxes through a linear income tax, t , and a uniform consumption tax, τ , to finance a lump-sum transfer β . The lump-sum transfer does not exclude voters from the informal sector, whatever the sector voters work for they enjoy the same level of lump-sum transfer β . Since no one can be taxed more than 100% of their income and provided that β should be positive, we obtain boundaries for t : $0 \leq t \leq 1$.

We assume indirect taxes have an administrative cost. The Government only gets $\lambda \in (0,1)$ of a dollar for each dollar collected to finance the lump-sum transfer. This means that $(1-\lambda)$ is the administrative cost of the indirect tax collection. The income tax has no administrative cost, since in our model the most important cost of the income tax instrument is tax evasion.

² In order to rank societies according to SSD for the lognormal distribution, we fix \bar{w} and then adjust mean of the natural logarithm (μ) accordingly.

Workers in the informal sector evade income taxes, but they can not evade consumption taxes. Therefore after-tax price of the consumption good equals: $1+\tau$.

The indirect utility of an informal sector worker:

$$V^n = \frac{n + \beta}{1 + \tau} \quad (3)$$

The indirect utility of a formal sector worker:

$$V^w = \frac{(1-t)w + \beta}{1 + \tau} \quad (4)$$

The tax schedule is purely redistributive, the Government budget constraint (GBC):

$$\beta = \lambda \tau \int_{W_I} \left(\frac{n + \beta}{1 + \tau} \right) f(w) dw + \lambda \tau \int_{W_F} \left(\frac{(1-t)w + \beta}{1 + \tau} \right) f(w) dw + t \int_{W_F} w f(w) dw$$

Where W_I and W_F are the set of informal and formal sector workers, respectively, which will be discussed in the Participation stage section.

From the (GBC) we can express the lump-sum transfer, β , as a function of the tax schedule (t, τ) :

$$\beta(t, \tau) = \frac{1}{1 + (1 - \lambda)\tau} \left(\lambda \tau n \int_{W_I} f(w) dw + (t(1 + (1 - \lambda)\tau) + \lambda \tau) \int_{W_F} w f(w) dw \right) \quad (5)$$

3. PARTICIPATION STAGE

A voter with earnings ability w decides to enter into the formal sector whenever his disposable income or consumption level in the sector is higher than the fixed consumption level in the informal sector, that is, if

$$\frac{(1-t)w + \beta}{1 + \tau} > \frac{n + \beta}{1 + \tau}$$

The lump-sum transfer and the indirect tax affect equally voters in both sectors; therefore they play no role determining the size of the informal sector workforce. Participation in the informal sector is affected by the after-tax income in the formal sector and the fixed income in the informal sector. When the latter is lower than the former a w -voter will decide to work in the formal sector. Since $t < 1$, consumption of a formal sector worker increases with the wage level, w . Then, for an income tax t , there exists a unique $w^*(t)$ that is indifferent between working in the informal sector and working in the formal sector.

$$w^*(t) = \frac{n}{1-t} \quad (6)$$

Note that the informal sector workforce is strictly positive for any t and $n > 0$. All voters with earnings ability $w \leq w^*(t)$ work in the informal sector and voters with $w > w^*(t)$ work in the formal sector and pay income taxes. The proportion of informal sector voters is $F(w^*)$. Notice that the size of the formal sector workforce decreases with t and n . It is worth noting that our previous results hold if we assume that the income in the informal sector is rather increasing in w , that is $n = n(w)$ with $n'(w) > 0$; as long as $n(\cdot)$ is concave, $n(0) > 0$ and $\lim_{n \rightarrow \infty} n(w) \leq 0$. Still, we would find a unique $w^*(t)$ that is indifferent between working in the informal sector and working in the formal sector.

From the (GBC) we can express the lump-sum transfer as a function of the income and consumption taxes and $w^*(t)$.

$$\beta(t, \tau) = \frac{1}{1 + (1 - \lambda)\tau} \left(\lambda n F(w^*) + (t(1 + (1 - \lambda)\tau) + \lambda\tau) \int_{w^*(t)}^{\infty} w f(w) dw \right) \quad (7)$$

The distribution of earnings ability will determine the size of the informal and formal sector, therefore the tax-base of the income tax instrument. The cost of the income tax is tax evasion while the cost of the consumption tax is the administrative cost $(1 - \lambda)$. If both tax instruments are

substitutes,³ politicians will rely more heavily on the income tax for high levels of $(1-\lambda)$. As n increases the cost of the income tax grows as participation in the formal sector decreases with n ($w^*(t)$ is an increasing function of n), other things equal, this should increase support towards the consumption tax.

We next determine voters' preferences over tax schedules (t, τ)

4. THE POLITICAL EQUILIBRIUM TAX-MIX

To better understand the effect of the distribution of wages on the equilibrium tax-mix, we next study voters' preferences over the income tax fixing the consumption tax to zero. We expect voters would replace income taxes with consumption taxes for a large potential informal sector or lower administrative cost (λ), if both tax instruments were substitutes.

4.1 Preferences over tax schedules (with $\tau=0$)

The lump-sum transfer when $\tau = 0$ is:

$$\beta(t,0) = t \int_{w^*(t)}^{\infty} wf(w)dw$$

For the Log-normal distribution of wages

$$\beta(t,0) = t\bar{w}\Phi\left(\frac{\mu + \sigma^2 - \ln(w^*(t))}{\sigma}\right)$$

Where $\Phi(\cdot)$ is the standard normal cumulative distribution function, $\bar{w} = \exp(\mu + (1/2)\sigma^2)$. Note that as $\tau=0$, if the income tax rate equals one, from the participation stage, no one will be willing to work in the formal sector, as a consequence the lump-sum transfer will be null. Therefore the income tax that

³ We prove in the appendix the substitutability of both tax instruments when earnings ability follow a Log-normal distribution.

maximizes the lump-sum transfer is strictly lower than one (and higher than zero).

An informal sector worker utility is simple $n+\beta(t,0)$. His preferred income tax is t_n that maximizes the lump-sum transfer $\beta(t,0)$. The utility of a formal sector worker is $(1-t)w+\beta(t,0)$ and it is maximized for t_w . Note that $t_w < t_n$, for all $w>0$; therefore the equilibrium tax is bounded above by t_n . We consider the cases where n is sufficiently small so that the voter with average earnings ability always works in the formal sector ($\bar{w} > w^*(t_n)$). This guarantees that the redistribution function or lump-sum transfer $\beta(t,0)$ is concave for $t \leq t_n$. Indeed the sign of the second derivative of $\beta(t,0)$ with respect to t equals the sign of:

$$t(\ln(w^*(t)) - \mu) - 2\sigma^2 = t(\ln(w^*(t)) - \ln(\bar{w})) - t\frac{1}{2}\sigma^2 - 2\sigma^2$$

We characterized voters' preferences over the income tax as a function of their marginal wage in Lemma 1.

Lemma 1: *There is a unique cut-off \tilde{w} such that: $V^{\tilde{w}}(t_{\tilde{w}}) = V^n(t_n)$. All voters with $w > \tilde{w}$ prefer t_w to t_n , that is, $V^w(t_w) > V^n(t_n)$; and all voters with $w \leq \tilde{w}$ prefer t_n to t_w , i.e., $V^w(t_w) \leq V^n(t_n)$.*

Proof: By an envelope theorem argument the following expression is an increasing function of w : $V^w(t_w) - V^n(t_n) = (1-t_w)w + \beta(t_w,0) - n - \beta(t_n,0)$ and equals zero at $w = \tilde{w}$.

Note that from Lemma 1, all voters with wage level $w \leq \tilde{w}$ prefer the tax rate, t_n which maximizes the lump-sum transfer β , i.e., the peak of the Laffer curve while voters with wage levels above \tilde{w} prefer to work in the formal sector facing a tax rate of t_w . The tax rate t_w is smaller the larger is w , provided that it is the solution to: $-w + \partial\beta/\partial t = 0$.

Proposition 1: *There is a unique equilibrium, the most preferred tax rate of the voter with median earnings ability. The equilibrium tax rate is such that if*

$m \leq \tilde{w}$ then, the equilibrium tax rate equals t_n and if instead $m > \tilde{w}$, then, the equilibrium tax rate equals t_m .

Proof: Preferences satisfy the single-crossing property: the preferred income tax rate is a non-increasing function of wage, w . If the median voter earnings ability is lower than \tilde{w} , then his most preferred tax is t_n , and so do voters poorer than the median, which explains why the equilibrium tax rate equals t_n if $m \leq \tilde{w}$. If instead $m > \tilde{w}$, the median most preferred tax would be t_m , any tax rate lower than t_m will be defeated by a coalition of voters poorer than \tilde{w} , and voters richer than \tilde{w} , will vote for t_m against a higher tax rate.

To understand how inequality affects the equilibrium tax and the size of the lump-sum transfer we disentangle two effects: the political effect and the tax base effect.

4.1.1 The political effect

Societies are ranked by SSD; they share by assumption the same average earnings ability, \bar{w} . Therefore as inequality increases earnings ability of the median voter decreases relative to average earnings ability.

A voter with earnings ability, w , working in the formal sector has a preferred tax t_w , his preferred income tax rate is such that:

$$-w + \frac{\partial \beta(t_w, 0)}{\partial t} = 0.$$

If β is concave in t at t_w , it is easy to show that, for a given inequality level, σ , from the implicit function theorem $d t_w/dw < 0$,

$$\frac{d t_w}{d w} = \frac{1}{\frac{\partial^2 \beta(t_w, 0)}{\partial t^2}} < 0$$

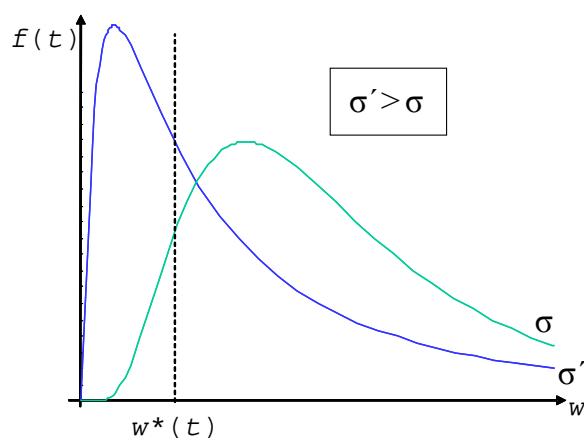
Keeping other things equal, if the earnings ability of the median decreases, the preferred tax rate and redistribution level preferred by the median will increase. If instead the median works in the informal sector, his income equals n . As inequality increases his earnings ability will decrease but his income will continue to be n . Therefore, the median preferred tax rate when working in the informal sector is the tax-rate maximizing redistribution (the peak of the Laffer curve). Keeping the tax-base effect caused by inequality aside, redistribution is expected to increase with inequality.

4.1.2 The tax base effect

Here we study the effect of inequality on the tax-base of the income tax and on the lump-sum transfer or redistribution level β .

Next we plot the density functions corresponding to two societies with earnings ability distributions $f_{\sigma'}$ and f_{σ} with $\sigma' > \sigma$. In equilibrium they will choose different income taxes as the median differs across societies. To disentangle the political effect, we fix the income tax to t . The voter indifferent between working and not working in the formal sector: $w^*(t)$, will coincide in both societies if we fix t .

Figure 1: the tax-base effect



The area below the density functions from zero to w^* represents the proportion of voters in societies σ' and σ working in the informal sector. The tax-base of the income tax will decrease as inequality increases, if inequality leads to an increase in the mass of voters with low earnings abilities. In this case the lump-sum transfer or redistribution level that can be financed with the same t will be smaller in society σ' compared to the more egalitarian society. The political effect and the tax-base effect will have opposite signs. Redistribution may decrease if the tax-base effect dominates the political effect. This is in contrast to the traditional Downsian model (Meltzer and Richard, 1981; Persson and Tabellini, 1994; Roberts, 1977; Romer, 1975) that predicts higher redistribution for more unequal societies.

Another possibility causing greater inequality is to have few voters earning a much higher income. In such a case the proportion of voters in the formal sector is roughly the same across societies σ' and σ , but the lump-sum transfer that can be financed with an income tax t increases in the unequal society as a consequence of the larger formal sector average wage. In this particular case, the political effect and the tax-base effect reinforce each other and equilibrium redistribution can only increase in response to higher inequality.

As can be seen in the numerical example in the appendix section, there is not a linear relationship between the lump-sum transfer/redistribution and inequality for $\tau=0$.

For the moment we have neglected the effect the consumption tax has on the equilibrium level of redistribution and the tax-mix.

4.2 Preferences over tax schedules (t, τ)

The empirical work of Kenny and Winer (2006) points out the importance of the tax base determining the resulting tax-mix. We study in this section the

political support for a consumption tax, or ad-valorem tax, τ , to finance redistribution. As a benchmark, the tax-mix that maximizes the weighted sum of utilities equals zero, because income taxation and indirect taxes are distortionary and generate no positive externality (apart from redistribution).

A positive indirect tax over consumption may emerge as an equilibrium outcome of the political process. The reason is that the indirect tax is another instrument to collect resources to redistribute. If this instrument distorts less than the income tax, then voters will agree to rely on it. We are also interested on the relationship between the equilibrium tax-mix and inequality as there are notable differences among countries. As stressed by Zolt and Bird (2005) and Auriol and Walters (2005), developing countries have limited tax-base to finance redistribution, in particular if redistribution has to be financed by income taxation. Hence, a shift toward consumption taxes, though regressive, is expected in presence of a tax-base problem as an alternative to the income tax.

The lump-sum transfer as a function of (t, τ) , with earnings ability following a log-normal distribution is,

$$\beta(t, \tau) = \frac{1}{1 + (1 - \lambda)\tau} \left(\lambda \pi n \Phi\left(\frac{\ln(w^*(t)) - \mu}{\sigma}\right) + \bar{w} (t(1 + (1 - \lambda)\tau) + \lambda\tau) \Phi\left(\frac{\mu + \sigma^2 - \ln(w^*(t))}{\sigma}\right) \right)$$

Both tax instruments are substitutes financing the lump-sum transfer (see the appendix for details). Therefore, we expect societies to rely more heavily on the indirect tax as the price of this instrument (the administrative cost) decreases. Then, we expect τ to be higher the higher is λ . The cost of the direct tax instrument comes from informal workers tax evasion. So, what determines a higher or lower reliance on the income tax instrument is more subtle. It depends on the wage of informal sector workers, n , that can be also be interpreted as the cost to be formal (Schneider, 2000; Gërkhani, 2004). But, inequality (σ) and the informal sector wage (n) determine the potential

informal sector size. Therefore inequality is also crucial shaping the equilibrium tax-mix.

We can extend Lemma 1 to the case of two tax instruments (t, τ) . Let (t_n, τ_n) be the tax vector maximizing $V^n = (n + \beta(t, \tau))/(1 + \tau)$, while (t_w, τ_w) maximizes $V^w = ((1-t)w + \beta(t, \tau))/(1 + \tau)$.

Lemma 2: *There is a unique cut-off \tilde{w} such that $V^{\tilde{w}}(t_{\tilde{w}}, \tau_{\tilde{w}}) = V^n(t_n, \tau_n)$. All voters with $w > \tilde{w}$ prefer (t_w, τ_w) to (t_n, τ_n) , that is, $V^w(t_w, \tau_w) > V^n(t_n, \tau_n)$; and all voters with $w \leq \tilde{w}$ prefer (t_n, τ_n) to (t_w, τ_w) , i.e., $V^w(t_w, \tau_w) \leq V^n(t_n, \tau_n)$.*

Proof: Note that $V^n(t_n, \tau_n)$ is independent of earnings ability. To have a society divided in two sectors with voters with earnings ability below \tilde{w} working in the informal sector and the rest in the formal sector, we simply need $V^w(t_w, \tau_w)$ to be increasing in w for all w . By an envelope theorem argument:

$$\frac{\partial V^w}{\partial w}(t_w, \tau_w) = (1 - t_w) > 0.$$

The utility function can be rewritten as:

$$V^n(t, \tau) = \frac{1}{1 + \tau} n + \frac{\beta(t, \tau)}{1 + \tau} \quad \text{and}$$

$$V^w(t, \tau) = \frac{(1-t)}{1 + \tau} w + \frac{\beta(t, \tau)}{1 + \tau}$$

The condition to have a Condorcet Winner in a multidimensional problem is fulfilled in our setting; this condition is called from Grandmont (1978), the Intermediate Preferences condition. The equilibrium tax-mix is either (t_w, τ_w) or (t_n, τ_n) , depending of the society (σ, n, λ) .

Proposition 2: *There is a unique equilibrium. The most preferred tax-mix of the median skill voter. The equilibrium tax-mix is such that if $m \leq \tilde{w}$ then, the equilibrium tax rate equals (t_n, τ_n) and if instead $m > \tilde{w}$, then, the equilibrium tax rate equals (t_m, τ_m) .*

Proof: Separation argument from Grandmont's Intermediate Preferences theorem. Informal workers all share the same preferences. Their consumption is maximized at (t_n, τ_n) , if the median works in the informal sector in equilibrium, so do all voters with earnings ability below the median.

The utility of the median voter working formally is,

$$V^m(t, \tau) = \frac{(1-t)}{1+\tau}m + \frac{\beta(t, \tau)}{1+\tau}$$

The median voter maximizes his utility at (t_m, τ_m) , for $(t, \tau) \neq (t_m, \tau_m)$ we have,

$$\frac{(1-t_m)}{1+\tau_m}m + \frac{\beta(t_m, \tau_m)}{1+\tau_m} > \frac{(1-t)}{1+\tau}m + \frac{\beta(t, \tau)}{1+\tau}$$

Assume, without loss of generality that $\frac{(1-t_m)}{1+\tau_m} - \frac{(1-t)}{1+\tau} > 0$. Rearranging terms

$$\text{we get: } m > \left(\frac{\beta(t, \tau)}{1+\tau} - \frac{\beta(t_m, \tau_m)}{1+\tau_m} \right) / \left(\frac{(1-t_m)}{1+\tau_m} - \frac{(1-t)}{1+\tau} \right)$$

Therefore, for all $w > m$, $V^w(t_m, \tau_m) > V^w(t, \tau)$. So, any tax-mix $(t, \tau) \neq (t_m, \tau_m)$ with $(1-t_m)/(1+\tau_m) - (1-t)/(1+\tau) > 0$ is going to be defeated by the most preferred tax-mix of the median by a coalition of the median and high income voters. Similar argument for $(1-t_m)/(1+\tau_m) - (1-t)/(1+\tau) \leq 0$, the median and low income voters (including informal sector workers for which $n < m$) support (t_m, τ_m) against any other tax-mix such that $(1-t_m)/(1+\tau_m) - (1-t)/(1+\tau) \leq 0$.

The political effect in a context of indirect and direct taxes would predict a higher income tax rate in societies where the median works in the

informal sector. By relying more heavily on income taxes the median in the informal sector will shift the burden of the tax to formal sector workers. Nevertheless this is not in line with what we observe, highly unequal societies have more than 40% of their working class working in the informal sector and still tend to rely more on indirect taxes to finance Government expenditure. In fact, the income/consumption tax ratio is of 1.2 in OECD countries while it equals 0.5 for a sample of developing countries (see Tanzi and Zee, 2000). In this model, this can only be explained by the tax-base effect. Inequality decreases the tax-base of the income tax instrument; a society will shift the burden of the tax to the consumption tax, whenever the last one is less costly relative to the cost of tax evasion associated to the income tax. In equilibrium, the political effect along with the tax-base effect will determine the tax-mix, the lump-sum transfer level and the size of the informal sector.

Next section presents results of the numerical examples.

5. THE POLITICAL EQUILIBRIUM TAX-MIX

We summarize here the main results for the numerical examples performed.

We consider for the numerical example a fixed mean earnings ability of $\bar{w} = 200$. The inequality parameter σ is the standard deviation of the variable (earnings ability) natural logarithm. The lowest inequality index is $\sigma = 0.4$ with a median to mean ratio of 0.923. The highest inequality index considered is $\sigma = 2.4$, with a median to mean ratio of 0.056. We deal with three different values for λ , $\lambda = \{0.8, 0.9, 0.95\}$, and three values for the informal sector wage n , $n = \{10, 20, 40\}$. Remember that $1-\lambda$ is the administrative cost of the consumption tax instrument, while n is a proxy for the cost of working formally, therefore a proxy for the income tax cost.

We find a cutoff for σ , above which the median works in the informal

sector, therefore the equilibrium tax-mix is characterized by (t_n, τ_n) . For σ sufficiently low the median works in the formal sector in equilibrium and the equilibrium tax-mix is given by (t_m, τ_m) . We next characterized σ cutoff for each parameter values. The median works in the informal sector for $\sigma \geq 1$ when $(\lambda, n) = (0.8, 40)$; for $\sigma \geq 1.2$ when $(\lambda, n) = \{(0.95, 40) \text{ or } (0.9, 40)\}$; for $\sigma \geq 1.4$ when $(\lambda, n) = \{(0.95, 20), (0.9, 10), (0.9, 20), (0.8, 10), \text{ or } (0.8, 20)\}$ and for $\sigma \geq 1.6$ when $(\lambda, n) = (0.95, 10)$.

In a context of direct and indirect taxes financing a lump-sum transfer, the political effect would predict the following: As the median to mean ratio decreases, the median would pressure for higher redistribution, if the median works in the informal sector, she will shift the burden of the tax to formal sector workers by increasing the income tax rate, t . On the contrary if the median works in the formal sector, he would substitute direct by indirect taxes to finance a given level of redistribution. Besides the political effect, to determine the implications of the tax-base effects we compare the costs of both tax instruments. Being both tax instruments substitutes financing redistribution, we expect societies to rely more heavily on the income tax instrument to finance a given level of redistribution when the relative cost of tax evasion is low compared to the cost of the consumption tax, that is as λ and n are low.

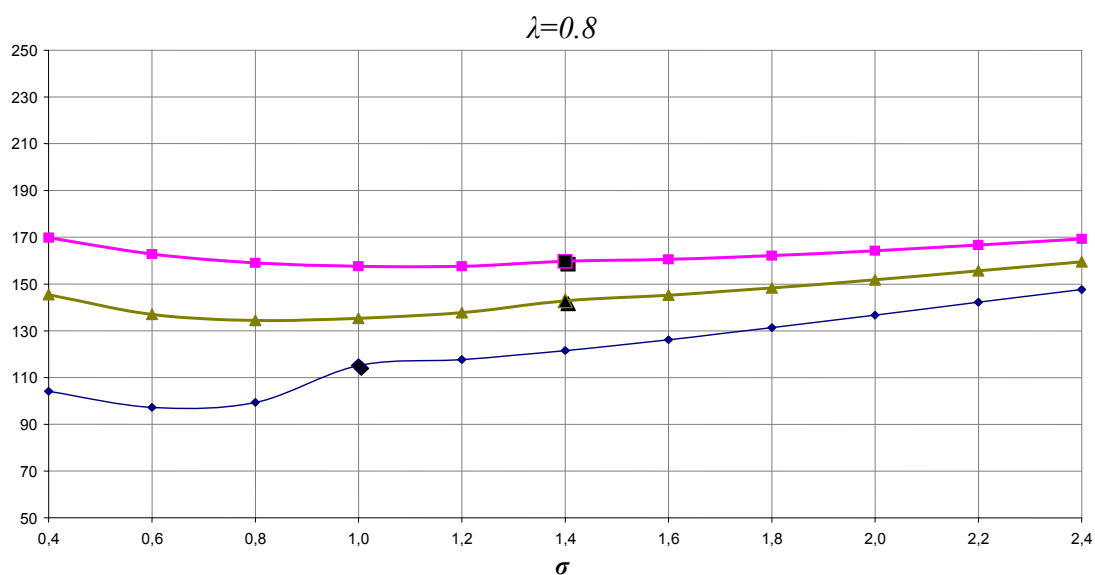
For all values of n and λ considered, we find a nonlinear relationship between redistribution (the lump-sum transfer) and inequality (see Figure 2). The equilibrium redistribution level and the equilibrium tax-mix is the result of the interaction of the political and tax-base effects.

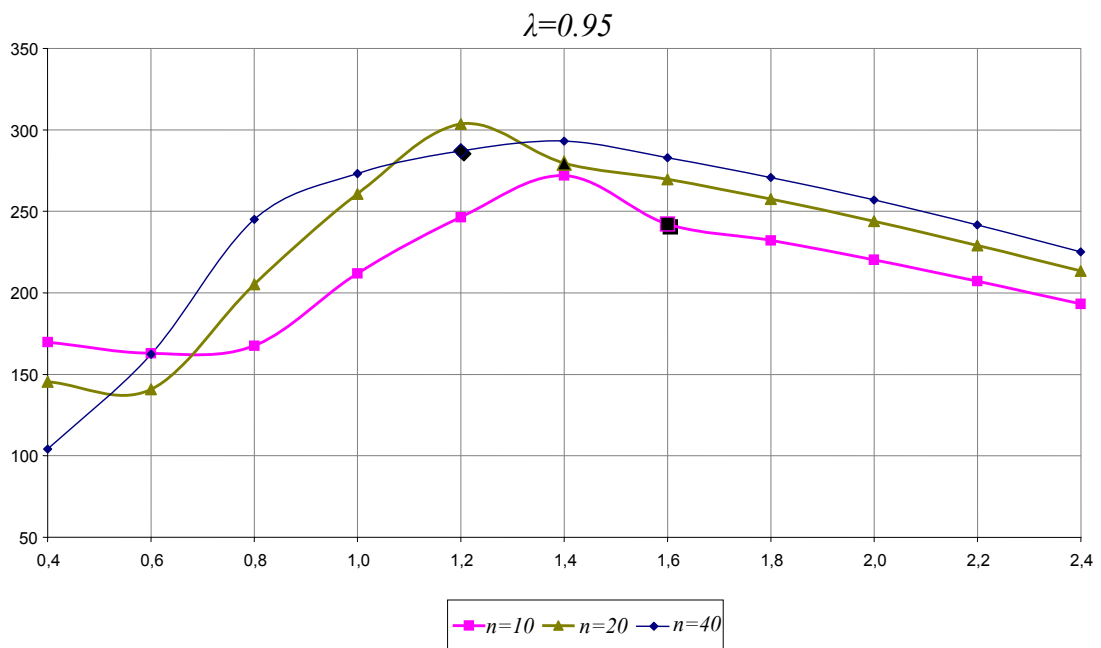
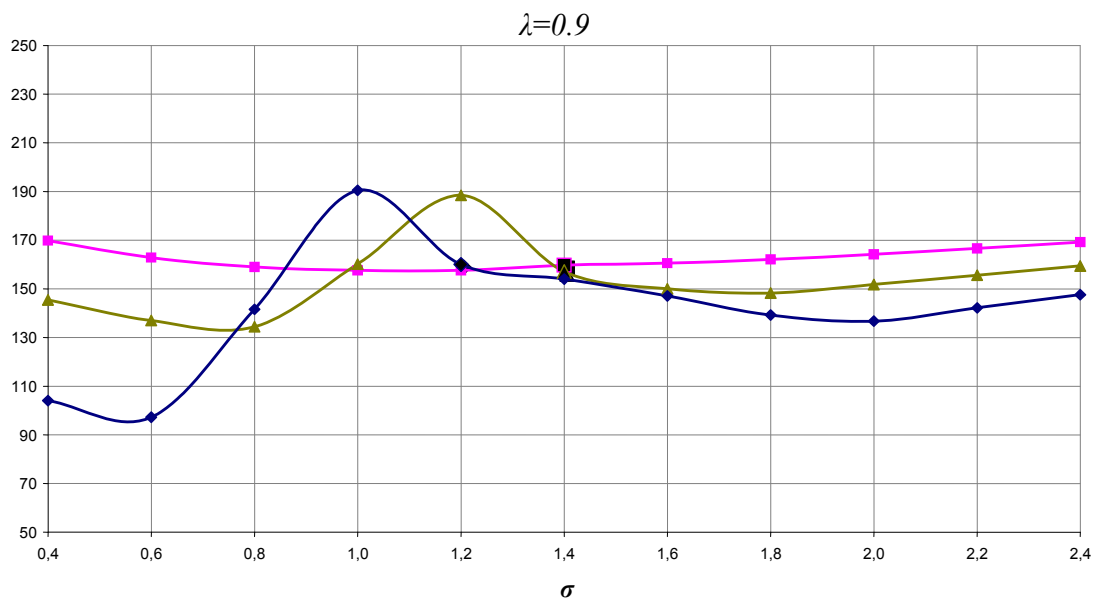
Figure 2 plots the equilibrium lump-sum transfer as a function of the inequality index, σ .⁴ For the highest administrative cost considered ($\lambda = 0.8$) the

⁴ The big and black point in each plot shows the inequality index above which the median works in the informal sector, in order to distinguish between the two types of equilibria: (t_m, τ_m) and (t_n, τ_n) . If σ is higher or equal than this cut-off value, then, the equilibrium is of the type (t_n, τ_n) .

equilibrium consumption tax equals zero for all levels of n and σ . When we set $\tau=0$, as in section 4.1, we find redistribution to be (somehow) U-shaped on inequality. Therefore for low levels of inequality the tax-base effect dominates the political effect. The introduction of the consumption tax allows for higher redistribution when inequality is high and the tax-base of the income tax is small. Still, there is a non-linear relationship between the lump-sum transfer and inequality; but it doesn't need to be U-shaped. Indeed for $\lambda=0.95$, redistribution is rather inverted U-shaped on inequality. In all cases (but one), at very low levels of inequality, redistribution decreases with inequality.

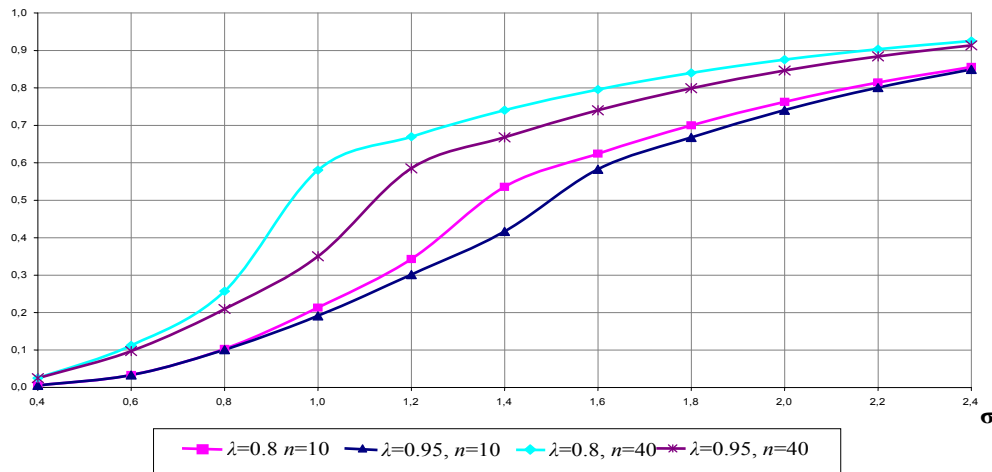
Figure 2: Equilibrium lump-sum transfer level, $\beta(t, \tau)$





Concerning the size of the informal sector, in all cases inequality increases the size of the informal sector workforce; which is in concordance with previous empirical findings (Chong and Gradstein, 2004). As expected the size of the informal sector is smaller in societies with lower n and higher λ (see Figure 3)

Figure 3: Equilibrium size of the informal sector workforce, $F(w^*(t))$.

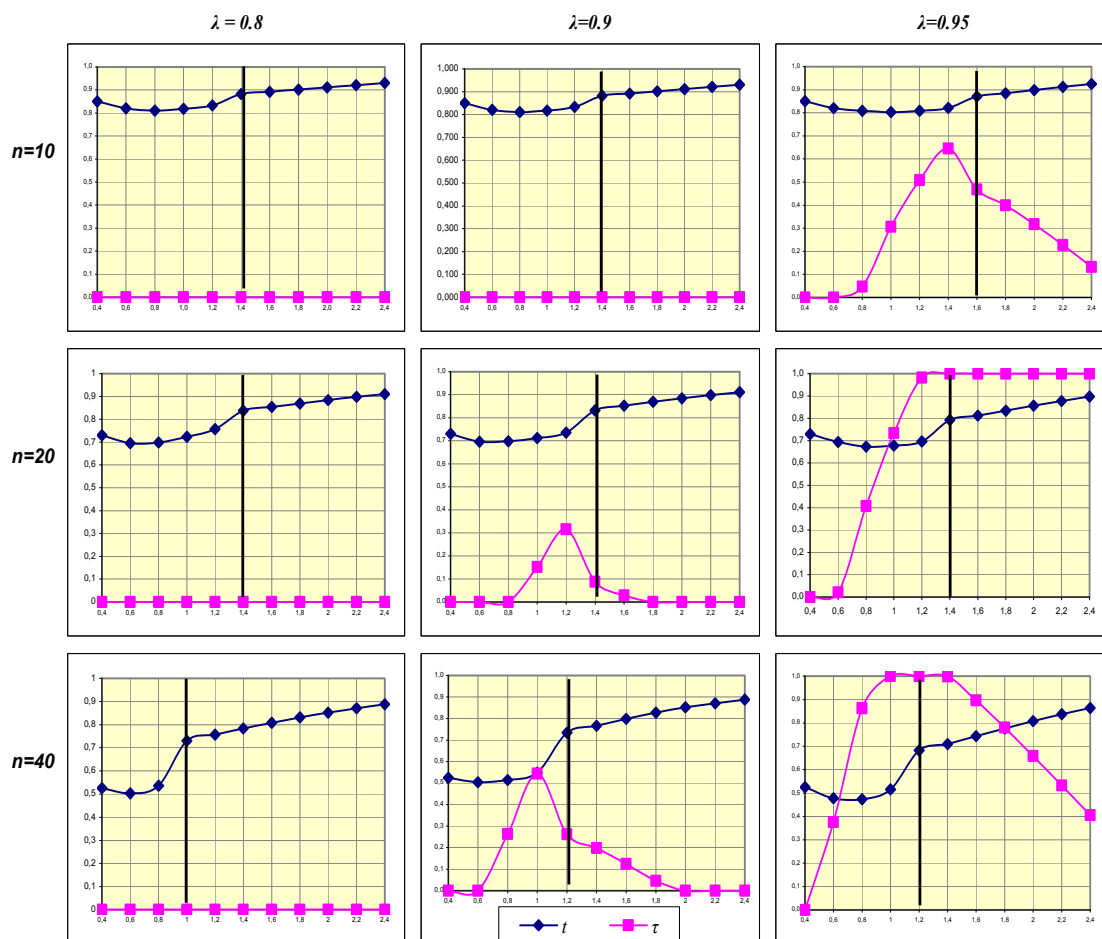


As regards to the tax-mix⁵ (see Figure 4), the income tax rate, t , is increasing in inequality as long as the median works in the informal sector, capturing the political effect. As a consequence of the tax-base effect the consumption tax rate is higher the higher is λ and the higher is n . We actually find the income tax to be higher than the consumption tax ($t > \tau$) when λ and n are low. For instance, for $\lambda=0.95$, relatively equal societies, with $\sigma=0.6$ and corresponding median to mean ratio $m/\bar{w} = 0.83$ have an income to

⁵ Figure 4 plots the income tax rate and the consumption tax rate as a function of inequality for all societies (n, λ) considered. The bold vertical line indicates the inequality index above which the median works in the informal sector. If σ is higher or equal than this cut-off value, then, the equilibrium is of the type (t_n, τ_n) , it will be of the type (t_m, τ_m) otherwise.

consumption tax ratio $t/\tau = 32.60$ for $n=20$ and $t/\tau = 1.27$ for $n=40$. In both cases the median works in the formal sector. For a higher inequality index $\sigma=1.6$, with a median to mean ratio of approximately $m/\bar{w} = 0.28$, the income to consumption tax ratios equal $t/\tau = 0.69$ and $t/\tau = 0.76$ for $n=20$ and $n=40$, respectively; with the median working in the informal sector in both cases. Such a relationship between the income and the consumption tax can only be explained from a tax-base perspective.

Figure 4: Equilibrium income and consumption tax, (t, τ) .



6. SUMMARY AND CONCLUSIONS

We present a political model where taxes and redistribution are chosen by majority voting. Traditional Downsian models would predict redistribution to be increasing in inequality, and the median voter to rely on tax instruments burdened by workers in a different sector than his own. Therefore observed facts about the relationship between inequality and redistribution and country comparisons on tax schedules remain a puzzle if taxes are chosen democratically.

We find that the introduction of an informal sector that evades income taxes accounts for the tax-base effect and helps us to understand why unequal societies redistribute less.

Numerical simulations show a non-linear relationship between equilibrium redistribution and inequality. As regards to the tax-mix, the income tax rate, t , is increasing in inequality as long as the median works in the informal sector, capturing the political effect. As a consequence of the tax-base effect the consumption tax rate is higher the lower are its administrative costs and the higher is the informal sector wage. If consumption taxes administrative costs are sufficiently low, we find that income to consumption tax ratios may be higher in relatively equal societies whereas they may be smaller than one (heavier reliance on consumption taxes) in relatively unequal societies; even if the median works in the formal sector for the relatively equal society while the median in the relatively unequal society works in the informal sector. Such a relationship between the income and consumption tax rates can only be explained from a tax-base perspective. For all parameters considered the size of the informal sector workforce increases with inequality.

This paper sheds light on the limitation of the income tax financing redistribution in developing countries even if taxes are democratically chosen. Nevertheless, political participation is found to be correlated with education,

therefore the income of the political median is probably higher than the median of the income distribution. Milanovic (1999) finds no empirical support to the median voter hypothesis, though in his study the political median seems to poorer than the actual median. Still, a combination of the tax-base and political effect will determine the level of redistribution, nevertheless the resulting relationship between inequality and redistribution is unclear. Moreover, we assume the lump-sum transfer doesn't discriminate between formal and informal sector workers, a richer set of expenditure policies will help us understanding the influence of the informal sector on the expenditure side of the Government. The introduction of education would add another important element to determine how redistribution would determine inequality. We left this other issues for further research.

7. APPENDIX: Substitutability of tax instruments, (t , τ)

Here we show that the income tax, t , and the consumption tax, τ , are substitutes financing the lump-sum transfer (or redistribution level) β .

$$\frac{\partial^2 \beta}{\partial t \partial \tau} = \frac{1}{\sigma \sqrt{2\pi} (1-t)(1+(1-\lambda)\tau)^2} \left(n \exp\left(-\left(\frac{\mu - \ln[w^*]}{\sqrt{2}\sigma}\right)^2\right) - \bar{w} \exp\left(-\left(\frac{\mu + \sigma^2 - \ln[w^*]}{\sqrt{2}\sigma}\right)^2\right) \right)$$

Where,

$$\text{sign}\left(\frac{\partial^2 \beta}{\partial t \partial \tau}\right) = \text{sign}\left(n \exp\left(-\left(\frac{\mu - \ln[w^*]}{\sqrt{2}\sigma}\right)^2\right) - \bar{w} \exp\left(-\left(\frac{\mu + \sigma^2 - \ln[w^*]}{\sqrt{2}\sigma}\right)^2\right)\right).$$

If β cross derivative is negative, then both tax instruments are substitutes, meaning that if the relative cost of a given tax instrument increases we can finance the same level of redistribution by substituting by the other tax

instrument. In order to rank societies according to SSD, the mean of the variable natural logarithm, μ , has to be adjusted so as to keep the mean earnings ability, \bar{w} , constant. As inequality increases, the mean of the earnings ability natural logarithm becomes: $\mu = \frac{1}{2}(2 \ln \bar{w} - \sigma^2)$. We replace the expression

for μ in $\frac{\partial^2 \beta}{\partial t \partial \tau}$ to study the sign of the cross derivative of β .

$$\begin{aligned}
& n \exp\left(-\left(\frac{\ln \bar{w} - \ln[w^*] - \frac{1}{2}\sigma^2}{\sqrt{2}\sigma}\right)^2\right) - \bar{w} \exp\left(-\left(\frac{-\frac{1}{2}\sigma^2 + \ln \bar{w} + \sigma^2 - \ln[w^*]}{\sqrt{2}\sigma}\right)^2\right) \\
& \Rightarrow n \exp\left(\left(\frac{2(\ln \bar{w} - \ln[w^*]) + \sigma^2}{2\sqrt{2}\sigma}\right)^2\right) - \left(\frac{2(\ln \bar{w} - \ln[w^*]) - \sigma^2}{2\sqrt{2}\sigma}\right)^2\right) - \bar{w} \\
& \Rightarrow n \exp\left(\frac{1}{8\sigma^2} \left((A + \sigma^2)^2 - (A - \sigma^2)^2 \right)\right) - \bar{w}; \quad A = 2(\ln \bar{w} - \ln[w^*]). \\
& \Rightarrow n \exp\left(\frac{A}{2}\right) - \bar{w} = n \exp(\ln \bar{w} - \ln[w^*]) - \bar{w}; \quad w^* = \frac{n}{1-t} \\
& \Rightarrow \text{sign}\left(\frac{\partial^2 \beta}{\partial t \partial \tau}\right) = \text{sign}(-t\bar{w}) < 0
\end{aligned}$$

This proves that both tax instruments are substitutes for all n , \bar{w} and σ , if earnings ability follows a lognormal distribution.

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