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REGIONAL REDISTRIBUTION AND GROWTH

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Abstract

In the last twenty years, Interregional Transfers in the form of public infrastructures have been used as an instrument to reduce regional disparities in output levels. In this paper we provide theoretical foundation on the effects of such transfers on both regional output and regional welfare disparities. We conduct our analysis in a multiregional framework considering a model with endogenous growth. Our results show that when increasing redistribution a reduction in regional output disparities might be compatible with a loss in total welfare. This result is due to the fact that such transfers force a reallocation of factors of production towards those regions with lower productivities and this has a negative effect on the growth rate of the economy.

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1 Introduction

One of the main arguments used to justify Inter-regional Transfers is that of e±ciency: private mobility decisions may lead to excessive concentration of production in those regions with higher productivities. Central Governments (CG from now on) intervene in order to e±ciently distribute the productive factors by reducing di®erences in regional endowments of public capital. Poorer regions receive large levels of public investment, which are partially ¯nanced with public revenues collected in the richer regions.

This type of policy has been widely believed to have positive e®ects on regional output levels. The conclusion has been that under free and perfect private capital mobility conditions, and assuming that public investment positively a®ects the marginal product of private capital, a reduction of regional di®erences in public capital stocks will reduce regional di®erences in output levels. Based on this argument, several European countries (those with large regional disparities), as well as the European Monetary Union, assign large amounts of public resources to the poorer regions in order to reduce di®erences in regional stocks of public capital.

However, this analysis has neglected the dynamic e®ects of Regional Redistribution (RR from now on) through interregional factor °ows and incentives for factor accumulation in each region. We will show that this neglect is not harmless. In this paper an exogenous increase in the level of public capital or infrastructure in the poorer regions has a direct positive e®ect on their output levels. Nevertheless, in order to properly analyze the e®ects of RR we take into account also: i) The impact on the donors, because they provide the resources to be redistributed and, ii) The economic links between the donor and the recipient. Therefore, we study the e®ects of Interregional Transfers on the rich regions and how these e®ects spread to the recipients through ¯scal and private capital interregional °ows.

There is a large literature on the e®ects of interregional redistributive policies. The literature on Fiscal Federalism provides many studies that focus on the design of instruments for Regional Redistribution to correct those distortions that are due to the existence of ¯scal externalities (see for instance Flatters, Henderson and Mieszkowski (1974), Wildasin (1983), Dahlby and Wilson (1994), Dahlby (1996) and Burbidge and Myers (1994), among others). According to this approach, Interregional Transfers might be used to achieve an e±cient allocation of public resources. However, in those papers Federal Government intervention is assumed to be through personal transfers that a®ect the agents` budget constraints rather than through the provision of productive public services. The fact that they deal with personal transfers does not allow to use these contributions in order to analyze the

e®ects of Regional Policy on economic e±ciency.

We must stress that we focus on the analysis of Interregional Transfers as an instrument to reduce regional di®erences in output levels rather than di®erences in regional incomes. In our framework, the CG reallocates public productive services to the poorer regions, therefore reducing regional di®erences in productivities. Given that a large portion of RR is done through the provision of public investment, based on e±ciency rather than equity arguments, it would be interesting to analyze the e®ects of RR when it a®ects the supply side of the economy by reallocating the factors of production (labor and private capital) across regions.

In this sense, our contribution to the Fiscal Federalism literature is that we use a model of Endogenous Growth in which a CG redistributes resources between regions by providing public services that enter the production function. This allows us to study the e®ects of RR on the level of gross product, private capital accumulation, consumption and welfare. Another contribution to this literature is that we show, contrary to what expected, that under certain conditions even the regions that receive the transfers could be worse o® in terms of welfare.

Barro (1990) and Barro and Sala-i-Martin (1992, 1995) have included government's provision of productive public services in an endogenous growth model. Their focus is on the relationship among productive government services, the distortionary taxes levied to pay for them and long run growth in a closed economy. They use di®erent types of public goods such as pure public goods or public goods subject to congestion. Clarida (1993) shows that, in small open economies, international aid that reduces the rental cost of private capital employed in the production of public capital allows to increase the optimal rate of public investment, the equilibrium rate of private investment and the speed of convergence to the steady state. The main di®erence of this paper is that he works with public capital stocks instead of non-accumulable public productive services.

Nevertheless, Regional Redistribution is not considered in any of the previous papers. Barro (1990) and Barro and Sala-i-Martin (1992, 1995) consider a single region and in Clarida's paper the provision of public expenditure is ¯nanced through international aid in the form of lump sum grants that are exogenous to the model, they do not have any economic cost for the recipient. This paper goes one step further. We introduce several regions and some of them receive additional public services ¯nanced through Interregional Transfers. This establishes a ¯scal link between the donor and the recipient. We show that redistribution introduces distortions on the donor and that these e®ects spread to the recipient through ¯scal and private capital interregional °ows.

It is important to note that we do not consider the accumulation of public capital as in Clarida (1993). Instead, we work with productive public services that are non-accumulable. It is true that, unless we assume a depreciation rate of public capital equal to one, it is the stock of public capital that a®ects the level of output. However, using this speci¯cation would yield a model with two sectors for which the transition to the steady state is very complex (see Mulligan and Sala-i-Martin (1992) and Caballé and Santos (1993)).

We must point out also that we do not introduce political economy considerations explicitly. Extending our analysis to a political economy approach would be quite interesting. However, we could not do it at no cost. Introducing those considerations in a dynamic set up makes our model cumbersome. Nevertheless, our results allow us to make some political considerations. Our results show that when increasing redistribution a reduction in regional output disparities could be compatible with a loss in total welfare. In this case, we cannot provide any political argument to explain redistribution, given that households in both economies (even those in the poor region) might be worse o®. In case that redistribution yields winners and losers it makes sense to study regional redistribution as the outcome of a voting process or the policy that maximizes a social welfare function.

There is a growing literature on the political economy of redistribution in a federal-regional set up (see Persson and Tabellini (1999) for an excellent survey). Two di®erent lines of research can be distinguished. On the one hand some authors (see Alesina and Spolaore (1997), Bolton and Roland (1997) and Ellingsen (1997), among others) focus their analysis on the political economy in processes of economic integration and secession. On the other hand, some others (see Besley and Coate (1998), Lockwood (1998), Inman and Rubinfeld (1997), etc.) study the role of di®erent constitutional procedures in processes of decentralization.

In section 2, we present the set up of the model. In section 3, main results concerning regional disparities, growth rates and welfare are provided. Finally, in section 4 we present the main conclusions.

2 The Model

We consider a country with several regions and a unique CG that provides public services and reallocates public resources across regions.[1] For simplicity, we assume that there are only two regions, one is poor (P) and the other is

[1] A natural extension of our model would be to consider a multi jurisdictional framework in which regional authorities may have ¯scal autonomy and may take decisions that contradict those taken by the Central Government.

rich (R). Differences between regions are based on differences in productivity.

Regions are linked through private capital flows and through the tax system because the CG imposes a unique tax (τ) which is the same in all regions. We use a proportional tax on the level of output, for simplicity.

2.1 Households

We consider the standard model of the representative, infinite-lived agent. The problem for the household in region i is to maximize the overall utility:

$$Max \int_0^{\infty} e^{-\rho t} \frac{c_{ti}^{1-\mu} - 1}{1-\mu} \, dt \tag{1}$$

$$s.t \ \dot{a}_{ti} = r a_{ti} + w_{ti} - c_{ti};$$

$$a_{0i} \geq 0; \ i = R; P;$$

where c_{ti} is consumption per capita and ρ is the rate of time preference. We define $\sigma = \frac{1}{\mu}$ (with $\mu > 0$) as the constant inter temporal elasticity of substitution. r is the market interest rate and w_{ti} represents the wages, households take them as given.

Agents hold the quantity a_{ti} of real assets in the form of ownership claims on capital. Households offer their capital to domestic firms and firms in other regions. Therefore

$$a_{it} = K_t^i + b_t^{id};$$

where K_t^i are domestic claims on capital in region i, and b_t^{id} denotes the interregional bonds demanded by households in region i. a_{0i} is the initial level of assets.[2] Redistribution will affect the household's decision of where to allocate them. That is, the levels of K_0^i and b_0^{id}.

Domestic and the other region's claims on capital are assumed to be perfect substitutes as stores of value. In equilibrium, households receive the same rate of return r on their assets no matter where they finally allocate them.

Another constraint is imposed in order to rule out the possibility of unbounded borrowing, although this constraint is also derived from the market equilibrium

[2] We may assume differences between a_{0R} and a_{0P}, but this is not relevant for the results . This difference is relevant when comparing regional levels of welfare, not when studying the effects of redistribution on regional welfare.

$$\lim_{t \to \infty} \left[a_{ti}\, e^{-\int_0^t (r(v) - n)dv} \right] \geq 0: \qquad (2)$$

We have to remark several important assumptions:

- Both regions have the same initial level of population, which is normalized to 1.
- The population growth rate is equal to zero.
- Labor is immobile and the labor supply is inelastic.
- All agents have the same preferences, independent of the region of residence. Therefore, θ and μ are the same for any representative agent.

2.2 Firms

The objective of the jth firm in region i is to maximize after-tax (τ is the tax rate on output) profits

$$Max\ \Pi_{jti} = (1 - \tau)Y_{jti} - rK_{jti} - w_{ti} L_{jti};\ i = R, P:$$

We assume that all firms have access to the same technology and that the production function for the jth producer in region i follows, as in Barro and Sala-i-Martin (1995):

$$Y_{jti} = A_i K_{jti}^{\alpha} (L_{jti} G_{ti})^{1-\alpha};\quad i = R, P; \qquad (3)$$

where $0 < \alpha < 1$.

G_{ti} represents the public services available for each producer in region i and how they affect production. This specification implies constant returns to scale in the private inputs. Therefore, for fixed G_{ti} there are diminishing returns to the accumulation of aggregate capital. But if G_{ti} rises along with K_{jti}, then diminishing returns will not arise, and the production function presents constant returns to scale in K_{jti} and G_{ti}. With this specification we allow for the possibility of endogenous growth.

In this set up no regional externalities are considered regarding G_{ti}: a increase of public services in one region does not increase the public services available to those firms producing in the other region. Finally, producers take G_{ti} as given.

A_i reflects regional-specific characteristics that affect production and it is exogenous to the model.[3] This is the source of differences between regions and we assume that $A_R > A_P$. This assumption is sufficient for $Y_{tR} > Y_{tP}$ to hold before redistribution.

Another important assumption of the model is that we allow for free and perfect capital mobility between regions. Producers in one region have access to capital from households in both regions. The level of capital input by producers in the ith region is

$$K_{it} = K_t^i + b_t^{is};$$

where K_t^i is the capital from domestic households in region i, and b_t^{is} is the supply of interregional bonds made by producers in region i.

In equilibrium, firms will pay the same r wherever they hire the capital.

The market clearing condition for the interregional bonds is

$$b_t^{Rs} + b_t^{Ps} = b_t^{Rd} + b_t^{Pd}.$$

2.3 The Government

In this multi-regional economy there is a CG that provides local public services (G_{ti}) that are used by firms in the production process.

The CG taxes a proportional tax on output at a rate ¿, which is the same in both regions. The national tax revenue collection from all regions at time t is

$$R_t = ¿(Y_{tR} + Y_{tP});$$

The Government satisfies the balanced budget constraint

$$G_t = R_t = ¿(Y_{tR} + Y_{tP}):$$

The Government applies the following redistribution policy: a share $\bar{}$ of the tax revenues collected in the richer region is used to provide additional public productive services to the poorer region. As we mentioned in the first section, our goal is not to analyze how $\bar{}$ is decided, but which are the effects of an exogenous level of redistribution. The amount of public services provided in both regions follows

[3] These characteristics may include natural resources with prohibitively transportation costs, social conditions, immobile factors, endowments of knowledge which are not transferable, etc. In short, all those characteristics that are taken into account by firms when deciding their location.

$$G_{tR} = \lambda(1 - \bar{\tau})Y_{tR};$$

$$G_{tP} = \lambda(Y_{tP} + \bar{\tau}Y_{tR});$$

with $0 \cdot \bar{\tau} \cdot 1$ and $0 \cdot \lambda \cdot 1$. The tax rate λ and the redistribution parameter $\bar{\tau}$ are constant and exogenous to individual decision-makers.

3 Results

In the next section we provide the results on the effects of regional redistribution on regional output disparities. In section 3.2 we present the effects of redistribution on regional and total welfare in the economy.

3.1 Regional disparities in output levels

The assumption of free and perfect capital mobility becomes crucial when analyzing the effects of regional redistribution on regional disparities in output levels. Another assumptions that are also crucial in our model are those of immobile workers and the inelastic supply of labor.

Considering those three assumptions, the after-tax profit maximizing conditions are different in the rich and in the poor region. In the rich region we have that capital input and labor will be demanded according to the following conditions:

$$PMg_{K_R} = (1 - \lambda) \cdot \alpha A_R^{\frac{1}{\alpha}} [\lambda(1 - \bar{\tau})]^{\frac{1-\alpha}{\alpha}} = r;$$

and

$$PMg_{L_R} = (1 - \lambda)(1 - \alpha) A_R^{\frac{1}{\alpha}} K_{tR} [\lambda(1 - \bar{\tau})]^{\frac{1-\alpha}{\alpha}} = w_{tR};$$

while in the poor region the conditions will take the form

$$PMg_{K_P} = (1 - \lambda) \cdot \alpha A_P K_{tP}^{\alpha-1} G_{tP}^{1-\alpha} = r;$$

and

$$PMg_{L_P} = (1 - \lambda)(1 - \alpha) A_P K_{tP}^{\alpha} G_{tP}^{1-\alpha} = w_{tP}.$$

The free and perfect capital mobility condition requires that in equilibrium marginal products of capital in both regions equalize:

$$A_R^{\frac{1}{\alpha}} \left[\varepsilon(1 - \tau)\right]^{\frac{1-\alpha}{\alpha}} = A_P \, K_{Pt}^{\alpha-1} \, G_{tP}^{1-\alpha}. \qquad (4)$$

Therefore, the rate of return to capital is the same in both regions and, more important, it is constant

$$r = (1 - \varepsilon) \, \alpha \, A_R^{\frac{1}{\alpha}} \left[\varepsilon(1 - \tau)\right]^{\frac{1-\alpha}{\alpha}} \qquad (5)$$

Based on the condition of capital mobility we derive some interesting results:

1 The ratio of regional output and private capital is constant through time.

$$\frac{Y_{tR}}{K_{tR}} = \frac{Y_{tP}}{K_{tP}} = A_R^{\frac{1}{\alpha}} \left[\varepsilon(1 - \tau)\right]^{\frac{1-\alpha}{\alpha}}$$

This implies that private capital and regional output in the rich region have the same rate of growth . The same is true in the poor region. Therefore $\gamma_{K_R} = \gamma_{Y_R}$ and $\gamma_{K_P} = \gamma_{Y_P}$

2 Private capital, public services and regional output in the poor region grow at the same rates

$$\gamma_{K_P} = \gamma_{G_P} = \gamma_{Y_P}$$

because, in equilibrium:

- $\frac{K_{Pt}}{G_{tP}}$, the ratio of private capital and public services in the poor region is constant.
- $\frac{Y_{Pt}}{G_{tP}}$; is constant also.

3 In equilibrium, the ratio of regional outputs as well as the ratio of regional levels of capital inputs is constant. This yields the result that the growth rates of regional outputs and capital inputs are the same in both regions $\gamma_{Y_R} = \gamma_{Y_P}$ and $\gamma_{K_R} = \gamma_{K_P}$

$$\frac{K_{tR}}{K_{tP}} = \frac{Y_{tR}}{Y_{tP}} = \frac{(1 - \tau)}{\tau} \left(\frac{A_R}{A_P}\right)^{\frac{1}{1-\alpha}} - \frac{1}{\tau} \qquad (6)$$

4 Regional redistribution reduces regional disparities in output levels. From equation (6) it is easy to show that more redistribution decreases the ratio of regional outputs

$$\frac{@(\frac{Y_{tR}}{Y_{tP}})}{@\tau} < 0$$

Our results derive from the fact that RR reallocates public resources from the productive region to the less-productive region. Therefore, RR compensates for differences in regional productivities. This is precisely where inefficiencies come from, because RR motivates a reallocation of factors of production due to the effects on the marginal products of capital.

When redistribution increases, the marginal product of capital in the rich regions decreases and producers in the rich region demand lower amounts of private capital input. However, producers in the poor region demand higher amounts of private capital input. That is why the ratio of capital inputs levels -equation (6)- is negatively related to redistribution.

The derivative of the ratio of regional outputs has the negative sign due to the impact that changes on K_{ti} have on Y_{ti}. When redistribution increases, the level of public services available to each producer in the rich region is reduced and there is a flow of private capital towards the poor region consequently. Economic activity in the rich region will be immediately reduced. Conversely, regional output in the poor region depends positively on redistribution due to the flow of private capital. Given that we are using an endogenous growth model the adjustment occurs instantaneously, there is no transition.

We must note that when increasing redistribution we consider only the possibility of eliminating completely regional output differences, such that $\frac{Y_R}{Y_P} \to 1$ after the economy is again in equilibrium. This happens for $\tau \cdot \frac{(A_R)^{\frac{1}{\alpha}} + (A_P)^{\frac{1}{\alpha}}}{(A_R)^{\frac{1}{\alpha}} + (A_P)^{\frac{1}{\alpha}}}$: If the CGxes τ such that $\frac{A_R}{A_P} < \left(\frac{1+\tau}{1-\tau}\right)^{\alpha}$; then $\frac{Y_R}{Y_P} < 1$. This is unsustainable however, for then the rich region becomes poor and in the next period it would receive grants. Therefore, τ is defined only in the interval $(0; \frac{(A_R)^{\frac{1}{\alpha}} + (A_P)^{\frac{1}{\alpha}}}{(A_R)^{\frac{1}{\alpha}} + (A_P)^{\frac{1}{\alpha}}}]$

The situation with $\tau = 0$ provides a result that is obvious due to the specification of the production function: all economic activity concentrates in one region. In this case, the marginal products of private capital in both

regions never equalize, because we assumed $A_R > A_P$. Therefore, the type of transfers that we are dealing with prevent excessive concentration of production in the region with higher productivity. Nevertheless, although with $\bar{} = 0$ the Marginal Product of Capital is the highest possible and households get the highest rate of return on their assets, this case does not assure that all agents will be better o® in terms of welfare, as it will be shown in the next section. This is because without redistribution the °ow of capital from the poor to the rich one will have a negative e®ect on the equilibrium wage in the poor region. If we want to analyze perfect capital mobility allowing for $\bar{} = 0$ we should introduce some kind of concavity on the private capital input. But this does not allow us to get endogenous growth and the transition to the steady state is very complicated.

Another important result is that the assumption of immobile workers allows regions to have di®erent equilibrium wages, $w_{tR} \neq w_{tP}$. More important, those wages depend on the regional levels of capital input, that are a®ected by the level of redistribution. This will have a signi¯cant impact on the households' budget constraints.

Therefore, Interregional Transfers succeed in the goal of reducing regional output disparities. This however does not say anything about the desirability of such a policy, which depends on the e®ects on welfare in each region. The impact on welfare depends on the e®ects of redistribution on the sources of income.

3.2 Welfare analysis

The solution to the problem of the household yields

$$\frac{\dot{c}_{ti}}{c_{ti}} = \frac{1}{\mu}[r - \rho] \quad 8\, i = R, P, \tag{7}$$

Once we take into account the free and perfect capital mobility condition and given that the interest rate is constant, it is easy to show that the consumption growth rate

$$°_c = \frac{\dot{c}_{ti}}{c_{ti}} = \frac{1}{\mu}\left[(1-¿)\,®\,A_R^{\frac{1}{®}}\,(¿(1-\bar{}))^{\frac{1-®}{®}} - \rho\right] \quad 8\, i = R, P, \tag{8}$$

is constant also. Equation (8) says that consumption in both regions grows at the same constant rate ($°_{c_R} = °_{c_P}$). It depends on both the tax rate (¿) and the redistribution parameter ($\bar{}$). One can observe that any increase in $\bar{}$ will have a negative impact on the growth rate of consumption. By increasing $\bar{}$ the CG lowers the amount of public services in the rich region and this a®ects negatively the rate of return on assets:

$$\frac{@\dot{c}}{@\bar{}} < 0:$$

A constant rate of return on assets allows to write the transversality condition to the household's problem as

$$\lim_{t \to 1} a_{ti}\, e^{i\, r\, t} = 0: \tag{9}$$

In the case that a_{ti} were negative, condition (2) imposes a limit to in¯nite borrowings. Some households cannot borrow in¯nitely because some others should hold assets at a rate for which the transversality condition (9) would not be satis¯ed. Therefore, (9) holds whether a_{ti} is positive or negative.

The solution to the di®erential equations

$$\dot{a}_{ti} = a_{ti}[(1 \text{ i } \text{¿}) \text{ ® } A_R^{\frac{1}{®}}\, (\text{¿}(1 \text{ i } \bar{}))^{\frac{1\text{ i }®}{®}} \text{ i } \text{½}] + w_{ti} \text{ i } c_{ti}; \qquad i = R; P \tag{10}$$

requires that we introduce several considerations:

- We ¯x the usual condition to have positive growth, which requires

  $$(1 \text{ i } \text{¿}) \text{ ® } A_R^{\frac{1}{®}}\, [\text{¿}(1 \text{ i } \bar{})]^{\frac{1\text{ i }®}{®}} > \text{½};$$

  and the usual bounded utility condition

  $$\text{½} > (1 \text{ i } \mu)\dot{c}:$$

- We write consumption as

  $$c_{it} = c(0)_i\, e^{\dot{c}t}; \; i = R; P;$$

  where $c(0)_i$ denotes the initial level of consumption in region i. In the following lines we will ¯nd the level of initial consumption that satis¯es the transversality condition.

- The equilibrium wages in both regions follow

  $$w_{tP} = r\, K_{tP} \frac{1 \text{ i } ®}{®} \text{ and } w_{tR} = r\, K_{tR} \frac{1 \text{ i } ®}{®}:$$

  The free and perfect capital mobility condition provides that, in equilibrium, the ratio of regional wages can be written as

  $$\frac{w_{tR}}{w_{tP}} = \frac{K_{tR}}{K_{tP}} = \frac{(1 \text{ i } \bar{})}{\bar{}} \left(\frac{A_R}{A_P}\right)^{\frac{1}{1\text{ i }®}} \text{ i } \frac{1}{=}: \tag{11}$$

[2] In this set up, the portion of assets, in equilibrium, that each household dedicates to domestic ¯rms and to ¯rms in the other region cannot be determined. Nevertheless, we know that in equilibrium all variables grow at the same rates in both regions. Therefore, it seems plausible that we assume that households will devote a constant portion of their assets to ¯rms in the poor and in the rich region. We denote Á as the fraction of assets of the household in the poor region that is dedicated to domestic ¯rms.[4] In equilibrium this fraction is constant through time but it depends positively on ¯: This is due to the initial positive e®ect of redistribution on the marginal product of capital of ¯rms in the poor region and the free and perfect capital mobility condition that provokes a increase in the demand of capital input by ¯rms in that region.

Given this assumption we can write

$$K_{tP} = Á\, a_{tP}$$

and

$$K_{tR} = (1 - Á)\, a_{tP} + a_{tR}$$

These considerations allow us to write equations in (10) as

$$\dot{a}_{tP} = a_{tP}\, r[1 + Á\, \frac{1 - ®}{®}] - c_{tP}; \tag{12}$$

$$\dot{a}_{tR} = a_{tR}\, \frac{r}{®} + r\, \frac{1 - ®}{®}\, (1 - Á)\, a_{tP} - c_{tR}; \tag{13}$$

3.2.1 Welfare in the poor region

By solving equation (12) we get that households devote a constant fraction of their assets to consumption

[4] We take the household in the poor region as the reference point. If we start from a situation with a low level of redistribution, given the free and perfect capital mobility condition the level of capital input in the rich region will be higher than that in the poor one, because the marginal product of capital in the rich region is higher. The private capital will °ow from the poor to the rich region. In this case $K_{tP} < a_{tP}$: As we increase redistribution, the ¯rm in the poor region demands more capital, therefore households in the poor region rent a larger portion of their assets to the domestic ¯rms. This represents that Á is increasing with respect to ¯: We could consider a di®erent situation with high redistribution in which the reference point would be the household in the rich region. Nevertheless, what is relevant is that the distribution of assets between domestic ¯rms and ¯rms in the other region is constant and dependent on ¯.

$$c_{tP} = \varphi_P a_{tP}$$

with $\varphi_P = r[1 + \acute{A}\frac{1-\theta}{\theta}] - \rho_c > 0$ due to the bounded utility condition. Therefore, φ_P depends on $\overline{\ }$. This solution yields that consumption and assets in the poor region grow at the same constant rates ($\gamma_c = \gamma_a$). This expression also tells us that all variables in the poor region grow at the same rates

$$\gamma_{K_P} = \gamma_{G_P} = \gamma_{Y_P} = \gamma_{a_P} = \gamma_{c_P}$$

Now we have that the level of consumption that satisfies the transversality condition is

$$c_{tP} = \varphi_P a(0)_P \ e^{\gamma_c t}$$

Substituting in the utility function (1) and integrating provides that the maximum level of utility attainable in the poor region is:

$$U_{maxP} = \frac{1}{(1-\mu)} \left[\frac{(\varphi_P a_{0P})^{1-\mu}}{\rho - \gamma_c(1-\mu)} - \frac{1}{\rho} \right];$$

Now we can compute the effect of redistribution on the level of welfare in the poor region. The derivative of the utility function with respect to $\overline{\ }$ is rather complex. The only thing that we can say is that if

$$\frac{\partial \acute{A}}{\partial \overline{\ }} \cdot \frac{1}{(1-\overline{\ })} \left[1 + (\frac{1-\theta}{\theta})\acute{A} - \frac{1}{\mu} \right]; \qquad (14)$$

then

$$\frac{\partial U_{maxP}}{\partial \overline{\ }} \cdot 0:$$

Intuitively, the model yields this result because redistribution has several opposite effects. First, it has a negative effect on the growth rate of the economy and on the returns on assets. Second, there is a initial positive effect on the level of capital input in the poor region, although in equilibrium, the marginal product of capital in the poor region decreases. Third, due to the increase in the level of capital input, there is a positive effect on the equilibrium wage in this region.

Redistribution allows households in the poor region to receive higher wages which may compensate the reduction in their returns on assets; this may finally have a positive effect on income and welfare. If labor was not to

be introduced, agents in the poor region would receive income from returns on assets only and redistribution would always have a negative effect on welfare. The final effect will depend on the composition of household's income, that is, on the weight of wages and returns on assets on total income. If wages are the main source of income for households in the poor region, it seems intuitive that more redistribution will increase their welfare.

If condition (14) does not hold, we cannot provide any definite result on the impact of redistribution on household's welfare.

3.2.2 Welfare in the rich region

Solving the differential equation (13) for the rich region considering the bounded utility condition as well as the positive growth rate condition provides

$$c_{tR} = \varphi_R a_{tP}$$

with $\varphi_R = \frac{r}{\theta} - \rho_c > 0$. Substituting into the utility function (1) and solving the integral, we get that the maximum level of utility attainable in the rich region is

$$U_{maxR} = \frac{1}{(1-\mu)}\left[\frac{\varphi_R a_{0R} + (1-\alpha)\, r^{\frac{1-\theta}{\theta}} a_{0P}^{1-\mu}}{(\rho - (1-\mu)\rho_c)} - \frac{1}{\rho}\right];$$

Again, it is rather complex to compute the effect of redistribution on the level of welfare of households in the rich region. The only result that we can provide is that if

$$\frac{\partial \alpha}{\partial \tau} > \frac{1}{(1-\tau)}\left[\frac{a(0)_R}{a(0)_P}\left(\frac{1}{\mu} - \frac{1}{\theta}\right) - \left(\frac{1-\theta}{\theta}\right)(1-\alpha)\right]; \qquad (15)$$

then

$$\frac{\partial U_R}{\partial \tau} < 0.$$

Although we do not show it formally, intuitively one should expect that redistribution will always have a negative effect on welfare in the rich region. We can identify three different negative effects of redistribution in the rich region. First, higher redistribution reduces the growth rate of the economy. Second, redistribution diminishes the rate of return on assets. Finally, capital flows to the poor region, and this has a negative effect on wages in the rich region.

If conditions (14) and (15) hold simultaneously, households in both regions, even those in the poor region, would be worse off with higher redistribution. If this was the case redistribution across regions would not make any sense. Redistribution would allow a reduction in regional output disparities at a cost of reducing total welfare.

If one of the conditions is not satisfied (it is not a sufficient condition), regional redistribution might have opposite effects on households in both regions. In this case, regional redistribution could be studied as the outcome of a voting process, as the result of a social welfare maximization problem, etc. Dealing with this considerations would require to assume a specific personal distribution of assets, to define voting processes, to consider the role of regional governments, etc. This however, would the topic of another paper.

4 Conclusions

In this paper we have analyzed the effects of Regional Redistribution in a model in which the Central Government provides public resources to all regions in the economy independently of the amount of taxes collected in each region. The Central Government provides additional public services to the poorer regions in order to reduce regional output disparities.

We have shown that this policy implies a reallocation of public productive services across regions which, under some specific assumptions, has several effects.

First, there is a reallocation of the stocks of private capital that motivates a reduction in regional output disparities. Under free and perfect capital mobility conditions, CG intervention modifies the Marginal Products of Capital in both regions which motivates interregional flows of capital and an increase in the level of output in the poor region. This intervention introduces some inefficiency because capital flows to the less-productive region.

Second, CG intervention has a negative effect on the growth rate of the economy. Regional Redistribution penalizes the rich region, which is the one that leads the economy due to its larger productivity of private capital. CG intervention negatively affects the rich region's growth rate and this effect spreads to the recipient region through fiscal and private capital flows.

Finally, we showed that although higher redistribution reduces regional output disparities, this reduction might be compatible with a decrease in total welfare. If several conditions are satisfied, it might be the case that higher redistribution implied lower levels of welfare in the poor region. This is because although redistribution has a positive effect on the equilibrium

wage in the poor region, it has a negative e®ect on the rate of return on assets.

A further extension of this paper would consider endogeneizing the political decision on the optimal level of redistribution. In this paper, we have considered that the level of redistribution is ¯xed but not how redistribution is decided.

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