SOCIAL SECURITY REGIME, GROWTH AND INCOME DISTRIBUTION

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Resumen

Este trabajo estudia el papel del régimen de seguridad social en la distribución del ingreso, la acumulación del capital, y en el crecimiento en un contexto de equilibrio general, utilizándose para ello un modelo de generaciones traslapadas con agentes heterogéneos. La heterogeneidad es introducida a través de la asignación de diferentes habilidades entre los individuos y la existencia de altruismo. Una característica clave del modelo es la introducción explícita del gobierno y su política fiscal. Luego, el modelo es utilizado para investigar las implicaciones empíricas de distintos regímenes de seguridad social y políticas redistributivas emprendidas por el gobierno en la distribución del ingreso, crecimiento, y acumulación del capital. El modelo teórico es calibrado de manera a ser comparados con los hechos estilizados de Brasil y EE.UU. El documento muestra que bajo ciertas políticas redistributivas tomadas por el gobierno, un sistema de reparto lleva a una peor distribución del ingreso y a un peor desempeño económico que un sistema de capitalización. Otra conclusión importante del documento es que la evidencia contradictoria respecto a la curva de Kuznets encontrada en la literatura empírica puede ser explicada por la relación simultánea entre la distribución del ingreso y el nivel de renta (una es exógenas a la otra). Esta relación conlleva a complejas interacciones entre la política fiscal y la distribución de las habilidades de la población. El documento concluye que la curva de Kuznets puede tener cualquier forma a nivel teórico, y la U invertida es sólo una de estas posibilidades que es compatible con una realización específica de política fiscal.

Abstract

This paper studies the role of social security on income distribution, capital accumulation and growth in a general equilibrium setup. An Overlapping Generations Model with heterogeneous agents is used. Heterogeneity is introduced by means of different abilities among individuals and non negative bequest motives. A key feature of the model is the explicit introduction of a government and its fiscal policy. The model is then used to investigate the empirical implications of different social security regimes and redistributional policies undertaken by the government on income distribution, growth, and capital accumulation. The theoretical model is calibrated in order to match some key stylized facts of Brazil and USA. The paper shows that under certain redistributional policies undertaken by the government, a pay-as-you-go system leads to more income inequality and a worse economic performance than a fully funded system. Another important implication of the paper is that the contradictory evidence regarding the Kuznets curve found in the empirical literature can be explained by the simultaneous relation between income distribution and level of income (one is not exogenous to the other). The relationship builds upon complex interactions between fiscal policy and the distribution of abilities of the population. Thus, the paper concludes that the Kuznets curve can have any arbitrary shape at a theoretical level, and the inverted U shape is only compatible with a particular realization of fiscal policies.

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I. INTRODUCTION

The effects of social security within the framework of overlapping generations models, have been extensively discussed in the literature.[1] Nevertheless, an integrated approach to asses the effects of social security in an economy has not been fully studied.

Some of the shortcomings of previous studies are that they usually emphasize on the welfare impact of a social security institution and not on its impact in growth. Moreover, there is lack for explicitly including a government.

Blanchard and Fisher (1989) focus on the effect of the social security regime on capital accumulation and thus on the level of disposable income for future consumption. Given some rather restrictive conditions between the rate of growth of the population and the real interest rate, they conclude that a fully funded system may lead to a capital accumulation path consistent with the optimal path for savings as opposed to a pay-as-you-go system. Given that they used the assumption of representative agents among generations, distributional impacts could not be analyzed.

On the other hand, Karni and Zilcha (1989) introduce heterogeneity by means of uncertain lifetime profiles and analyze the effect of the social security system on the distribution of income. They concluded that, within their analytical framework, a fair fully funded social security program may contribute towards greater income inequality and have adverse aggregate economic consequences.

From an empirical point of view, many authors have tried to study the relationship between income inequality, per capita level of income, and growth. Kuznets (1955) popularized the inverted U shape hypothesis between inequality and per capita income. His conclusions drawn from casual observations state that income inequality raises with per capita income until a point in which the relationship is reversed.[2]

This paper studies the effects of the role of social security on income distribution, capital accumulation and growth in a more general setup. The main feature of the model is the introduction of a government in a more explicit way than done before. Different distributional concerns from the point of view of the policy maker may (and as our model shows can) lead to

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[1] See for example Barro [1974], Sheshinski and Weiss [1981], Karni and Zilcha [1986, 1989] and Chiu [1992].

[2] Papanek [1986] presents a panel data model in order to test the Kuznets hypothesis. There is no general consensus regarding this hypothesis. One stylized fact seems to be that there is no strong correlation between growth and inequality, and that the Kuznets hypothesis cannot be always accepted.

different "shapes" for the Kuznets curve. Heterogeneity is introduced by means of different abilities among individuals.

The paper is organized as follows: Section II presents the theoretical framework. Section III compares a calibration of the model sketched in the previous section with actual data from Brazil and USA. Finally, section IV summarizes the main conclusions and suggests further research.

II. THEORETICAL FRAMEWORK

We will consider an overlapping generations model with heterogeneous agents who live for two periods. The first period is a working period and in the second period the agents retire; at the end of the first period each individual gives birth to one offspring. Each agent can have one of the following productivity levels: high (h) or low (o) which are observable by the firm. There is no population growth so that the total number of individuals in a generation is equal to N[3] That is, there are N young individuals and N old ones. The market economy is composed by households, competitive firms and a government. There is only one good in this economy which is produced by a constant returns to scale technology. There is an inelastic labor supply and an asset market with private bonds. We also assume a non negative bequest motive and a social security institution operated by the government in the pay-as-you-go system.

We now analyze the optimization problems of the firms, households and the government; to derive the market equilibrium.

Firms:

Firms act competitively, hiring labor to the point where the marginal product of labor is equal to the wage; and renting capital to the point where the marginal product of capital is equal to its rental price. The production function is assumed to satisfy the Inada conditions. That is, each firm maximizes profits, taking the wage rate and rental rate on capital as given. Since we consider heterogeneous agents, there will be low and high ability agents, each of them earning different wages.

$$\pi_t = \omega_t K_t^{\beta} L_{h,t}^{\gamma} L_{o,t}^{1-\beta-\gamma} - r_t K_t - w_{h,t} L_{h,t} - w_{o,t} L_{o,t} \qquad (1)$$

[3] For references on Endogenous Growth see Saint-Paul (1992) and Corsetti (1994).

where ω_t is a technology shock, $L_{h,t}$ is labor of type h working in period t, $L_{o,t}$ is labor of type o working in period t, r_t is the rental price of capital, K_t is capital stock in period t, and $w_{i,t}$ (i=h,o) is the wage rate of the individual of type i.

The FONC for profit maximization of the firm are:

$$w_{o,t} = (1-\beta-\gamma)\omega_t K_t^{\beta} L_{h,t}^{\gamma} L_{o,t}^{-\beta-\gamma} \quad \textbf{(2)}$$

$$w_{h,t} = \gamma\, \omega_t K_t^{\beta} L_{h,t}^{\gamma-1} L_{o,t}^{1-\beta-\gamma} \quad \textbf{(3)}$$

$$r_t = \beta \omega_t K_t^{\beta-1} L_{h,t}^{\gamma} L_{o,t}^{1-\beta-\gamma} \quad \textbf{(4)}$$

We will assume that ω_{t+1}/ω_t follows a stationary first order Markov process, with unconditional mean greater than one, thus allowing for output to grow due, in part, to exogenous technological changes.

Notice that if we divide **(3)** by **(2)** we obtain the following expression:

$$\frac{w_{h,t}}{w_{o,t}} = \frac{\gamma\, L_{o,t}}{(1-\beta-\gamma)\, L_{h,t}} \quad \textbf{(5)}$$

Hence, if we assume that γ>1-β-γ (i.e. that the unconditional marginal productivity of type h agents is higher than of type o agents) we find that, for example, when the population is evenly distributed between both types of labor, the wage of the h type agent will be higher than the wage of the o type agent. The type of the agents is observable by the firm hence this is a straight forward version of a separating equilibrium.

Households:

Since the agents work only in the first period, they consume part of their first-period income and save the rest to finance their second-period retirement consumption. The assumption of altruism reflects the concern for the welfare of future generations; therefore each generation cares about its own utility and the utility of the next generation. In the second-period the agent does not consume all his wealth, leaving a bequest to the next generation. Agents born at time t face the following maximization problem:[4]

$$\max \; E_t\left[\alpha_1 \ln c_{1,t}^i + \alpha_2 \ln c_{2,t+1}^i + \alpha_3 \ln b_{t+1}^i\right] \quad \textbf{(6)}$$

subject to:

[4] Assume that the utility function is additive separable in consumption, and that the bequests enter separably in the utility of the individual; the last term of the equation may be interpreted as the indirect utility function of the young generation in period t+1.

$$\left(1-\tau_t^m\right)w_{m,t}+b_t^i+\frac{\theta_{t+1}^m}{1+r_{t+1}}=c_{1,t}^i+\frac{c_{2,t+1}^i}{1+r_{t+1}}+\frac{b_{t+1}^i}{1+r_{t+1}} \qquad (7)$$

where i=1,...,N indexes the individuals; α_j >0; j=1,2,3; m=o,h; where m indicates the type of the individual, where the type is assumed to follow a first order stationary Markov process. This amounts to assume that the abilities of the individual are correlated to his parents abilities; therefore when an individual is born he has a greater probability of "inheriting" his parents ability.[5] E_t, due to rational expectations, denotes expectation conditional on the information available on period t. c^i_{qt} denotes the consumption in period t of the i^{th} agent at stage q (q=1 for young and q=2 for old). Similarly, b^i_t is the bequest left to his offspring by the agent of family i when old at period t. θ^m_t is the social security transfer that an agent of type m receives when retired at time t. Finally, r_t denotes the real interest rate (equal to the rental price of capital) and τ^m_t is the labor income tax that the government levies from agent of type m working at period t.

It can be shown that the optimal consumption, savings, and bequest solutions are:

$$c_{1,t}^i = \frac{\alpha_1}{\sum_{j=1}^{3}\alpha_j}\left[\left(1-\tau_t^m\right)w_{m,t}+b_t^i+E_t\left(\frac{\theta_{t+1}^m}{1+r_{t+1}}\right)\right] \qquad (8)$$

$$c_{2,t+1}^i=\frac{\alpha_2}{\sum_{j=i}^{3}\alpha_j}\left(1+r_{t+1}\right)\left[\left(1+r_{t+1}\right)w_t^m+b_t^i+\frac{\theta_{t+1}^m}{1+r_{t+1}}\right] \qquad (9)$$

$$s_t^i=\frac{1}{\sum_{j=i}^{3}\alpha_j}\left[\left(\alpha_2+\alpha_3\right)\left[\left(1-\tau_t^m\right)+b_t^i\right]-\alpha_1 E_t\left(\frac{\theta_{t+1}^m}{1+r_{t+1}}\right)\right] \qquad (10)$$

[5] In the sociology literature (e.g. Shaowen and Yaoxian, 1992) and in the psychology literature (e.g. De-Graaf, 1992; Roscoe and Peterson, 1989; McGillicudy and Ann, 1992; Steelman and Powell, 1991). These studies show a positive correlation between parents ability and child ability; that is, given that your parents are of a certain ability the probability that you are going to be of the same type or at least similar is high; taking into account that ability depends on education level, family background and so on. For more details see the specific literature.

$$b_{t+1} = \frac{\alpha_3}{\sum_{j=i}^{3} \alpha_j}(1+r_{t+1})\left[(1-\tau_t^m)w_t^m + b_t^i + \frac{\theta_{t+1}^m}{1+r_{t+1}}\right] \qquad (11)$$

Government:

The government satisfies the following budget constraint at every period t:

$$G_t = \left[N_t^h \tau_t^h w_t^h + (N - N_t^h)\tau_t^o w_t^o\right](1-\varepsilon_t) \qquad (12)$$

where N_t^h are the agents with ability h that work in period t and N-N_t^h are the agents with ability o that work in period t.

The government has many policies that can be pursued. We do not set an explicit objective function for the government (G is not in the utility function of the agents since it is assumed that there is no productivity service from the government expenditure to the society). There are several instruments that the government might use to redistribute income in this economy; one of them is the way it sets the labor income tax. For instance, τ_t^m may depend on w_t^m; so if the government has a progressive tax policy this will imply that $\tau^h > \tau^o$ whenever $w^h > w^o$.

ε_t is another policy of the government, that determines the fraction of total revenue that the government redistributes to the old people in the form of social security transfers. This set up presents a generalized version of a "pay-as-you-go" system with heterogeneous agents.

Notice that if ε_t=0, given the existence of asset markets, this set up will also allow us to analyze a fully funded system.

Let the "average transfer" be defined by:

$$T_t = \frac{\varepsilon_t\left[N_t^h \tau_t^h w_t^h + (N - N_t^h)\tau_t^o w_t^o\right]}{N} \qquad (13)$$

$$\delta_{t-1} = \frac{\tau_{t-1}^h w_{t-1}^h}{\tau_{t-1}^o w_{t-1}^o} \qquad (14)$$

Where δ_t is the ratio of per capita revenue from each type of individual in period t. Consider this specific policy:

$$\theta_t^o = \frac{N T_t}{N_{t-1}^h \delta_{t-1} + N_{t-1}^o}, \quad \theta_t^h = \delta_{t-1}\theta_t^o \qquad \Rightarrow NT_t = N_{t-1}^h \theta_t^h + N_{t-1}^o \theta_{t-1}^o \qquad (15)$$

Obviously if $\delta > 1$ this implies that $\theta^h > \theta^o$; that is if you give more while young, you receive more when old. Equivalently using **(12)** we can express **(15)** as:

$$\theta_t^o = \frac{\varepsilon_t G_t}{(1-\varepsilon_t)(N_{t-1}^h \delta_{t-1} + N_{t-1}^o)} \qquad \theta_t^h = \frac{\delta_{t-1}\varepsilon_t G_t}{(1-\varepsilon_t)(N_{t-1}^H \delta_t + N_{t-1}^o)} \tag{16}$$

Equilibrium:

Labor market equilibrium requires that demand equal supply for each type of agent. That is, when the wage and rental rate on capital are such that firms wish to use the available amounts of labor of each type of agent and capital services. The factor market equilibrium conditions are therefore given by the equations below:

$$L_{h,t} = N_t^h \qquad L_{o,t} = N - N_t^h \tag{17}$$

The goods market equilibrium requires that the demand for goods in each period equals the supply, or equivalently investment should be equal to saving, then it is easy to verify that, given the condition below, this will be satisfied.

$$K_t = \sum_{i=1}^{N} s_{t-1}^i \quad \Rightarrow \quad C_{1,t} + C_{2,t} + G_t + K_{t+1} - K_t = Y_t \tag{18}$$

where:

$$C_{1,t} + C_{2,t} = \sum_{i=1}^{N} (c_{1,t}^i + c_{2,t}^i)$$

and Y_t is the total output (the production function).

Even though we arrived to analytic solutions for the optimal policies of the agents and firms, due to heterogeneity, the equilibrium needs to be solved with rather complex non linear systems of equations to determine the aggregate level of savings (and thus capital accumulation) from which we back up the individual decisions. Notice that the optimal policies of consumption depend on the perception of the agents not only about the redistributional policies due to social security, but also to the taxing policy of the government and the distribution of the abilities of the individuals among the population.

In short, even with this simple set up we need to rely on numerical methods to answer questions such as the ones posed in the Introduction.

III. EMPIRICAL ANALYSIS AND RESULTS

This section is divided in two parts, the first introduces some key stylized facts for Brazil and USA that are going to be ultimately compared with simulations of the theoretical model calibrated for these economies.

Figure 1
Income Inequality and the Level of Per Capita Income
(Brazil: 1976-90)

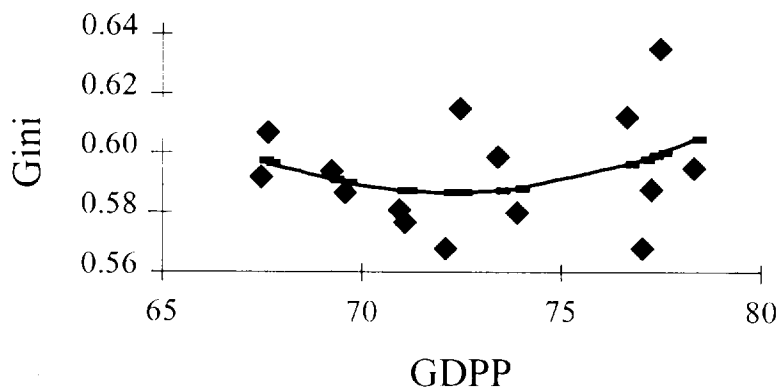
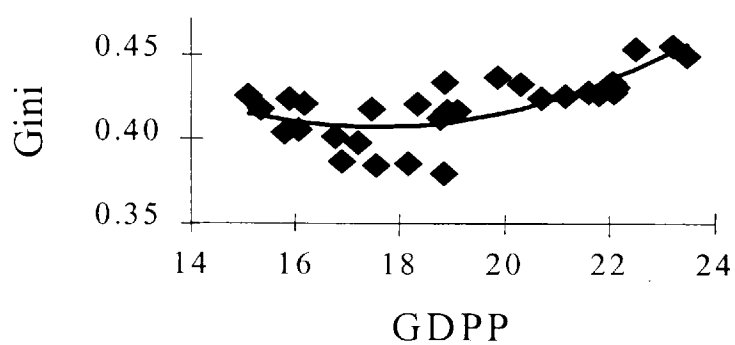


Figure 2
Income Inequality and the Level of Per Capita Income
(USA: 1945-95)



The two figures shown above present scatter plots of the Gini coefficient and the level of per capita income. In both cases a quadratic curve has been fitted to evaluate the Kuznets hypothesis unconditionally (that is with out controlling for other factors). It is evident that in both cases the inverted U shape does not appear. On the contrary, if the relation between this series is non linear it has a U shape. Nevertheless, in both cases this relation is not statistically significant. Table 1 present a more formal measure of the relationship of the pertinent time series.

Table 1
Stylized Facts

	BRAZIL (1976-90)	US (1949-95)
Gini (Mean)	0.593	0.418
Gini (Var.Coeff.)	0.030	0.045
GGDPP (Mean)	1.010	1.016
GGDPP (Var.Coeff.)	0.044	0.021
GY (Mean)	0.244	0.219
GY (Var.Coeff.)	0.279	0.097
Corr(Gini, Gini(-1))	0.732	0.814
Corr(GDPP, Gini)	0.269	0.642
Corr(GDPP2, Gini)	0.272	0.659
Corr(GGDPP, Gini)	-0.137	0.024
Regression:		
GDPP	-0.060 (0.020)	-0.069 (0.551)
GDPP2	0.0004 (0.0001)	0.002 (0.0009)
GGDPP	0.129 (0.048)	
GY		-8.908 (3.140)
GY2	0.515 (0.48)	19.868 (6.924)
Gini (-5)		-0.536 (0.166)
Gini (-7)		-0.565 (0.130)
R^2	0.865	0.892

Notes: Gini = Gini Coefficient. GDPP = level of per capita income. GDPP2 = The square of GDPP. GGDPP = GDP gross growth rate. GY = Ratio of Government Expenditure to GDP. GY2 = GY squared. INV = Investment. Values in parenthesis denote standard errors of the coefficients.

Brazil is considered as the country who has the highest income inequality, measured by Gini coefficients. It can be noticed that inequality seems to be rather stable as the Variation Coefficient of the Gini makes clear. On the other hand, the US has a per capita income growth higher and less volatile than Brazil's. Both countries have approximately the same size of

government relative to their GDP. In both cases, income inequality measured by the Gini coefficient is very persistent. Even after controlling for other factors, Kuznets inverted U shape does not appear in the data. On the contrary, if any relation between inequality and the level of income appears it is, in both countries, precisely in the opposite direction that Kuznets hypothesized. In both cases, the size of the government appears as significative, presenting a U shape.

These statistics alone show important disparities in economic performance and distribution between economies. In both cases, however, no sign of the popular inverted U shape appears on the data. A major challenge undertaken below, is to parameterize the theoretical model in order to evaluate if it is able to replicate some of this results reported in Table 1.

In order to learn more about the time series implications of the theoretical model proposed in the earlier section, we present some results of simulations with rather extreme assumptions about the fiscal policies of the government and the social security regime. We will not attempt to calibrate the model to any particular economy, but to observe how different arrangements in terms of the social security regime modify some of the stylized facts previously described.

To do so, we need to give specific values to the parameters in the theoretical model. For the base model these values were:

Preferences: α_1=1, α_2=0.8, α_3=0.5;

Technology: β=0.35, γ=0.45;

Population: N=7

Technology Shocks: $\eta \equiv \frac{\varpi_{t+1}}{\varpi_t}$; η_1=1.15, η_2=0.90.

$$\begin{bmatrix} P(\eta_{t+1} \setminus \eta_t = 1) \\ P(\eta_{t+1} \setminus \eta_t = 0) \end{bmatrix} = \begin{bmatrix} 0.86 & 0.14 \\ 0.14 & 0.86 \end{bmatrix}$$

where η represents the possible rates of growth of the technology shock and P(·) is its transition matrix. As can be observed, these values are consistent with an economy growing (in average) and persistent shocks in the Solow residual.

Finally we specify the values adopted for the Fiscal Policy variables.

Income Tax: τ_1=0.3, τ_2=0.1; where:

$$\tau^h = \begin{cases} \tau_1 \ if \ \ w^h > w^o \\ \tau_2 \ otherwise \end{cases}$$

Social Security Transfers: ε_1=0.12, ε_2=0.08;

$$\begin{bmatrix} P(\varepsilon_{t+1} \setminus \varepsilon_t = 1, \eta_t = 1) \\ P(\varepsilon_{t+1} \setminus \varepsilon_t = 0, \eta_t = 1) \\ P(\varepsilon_{t+1} \setminus \varepsilon_t = 1, \eta_t = 0) \\ P(\varepsilon_{t+1} \setminus \varepsilon_t = 0, \eta_t = 0) \end{bmatrix} = \begin{bmatrix} 0.65 & 0.35 \\ 0.40 & 0.60 \\ 0.60 & 0.40 \\ 0.35 & 0.65 \end{bmatrix}$$

We allow for social security transfers to vary pro-cyclically given that in both economies the government expenditure-GDP ratio is negatively related with the level of Per Capita Income. This allows for counter-cyclical government expenditure given that G and ε are negatively related in our theoretical model.

The experiments performed and the results of the calibration are summarized in Table 2[6].

Table 2.
Some Results of the Theoretical Model

Facts	Model 1	Model 2	Model 3
Gi	0.244 (0.037)	0.194 (0.033)	0.182 (0.028)
GGDPP	1.069 (0.064)	1.047 (0.061)	1.043 (0.074)
Corr(Gi,GDPP)	-0.155 (0.333)	-0.288 (0.294)	-0.233 (0.282)
Corr(Gi,GDPP2)	0.045 (0.357)	0.106 (0.311)	0.103 (0.305)
Corr(Gi,GGDPP)	0.155 (0.210)	0.135 (0.219)	0.131 (0.217)
Regression:			
GDPP	0.088 (0.182)	0.015 (0.143)	-0.035 (0.207)
GDPP2	0.020 (0.055)	0.015 (0.031)	0.004 (0.049)
GGDPP	0.081 (0.119)	0.065 (0.091)	0.067 (0.094)
GY	0.036 (0.044)	0.216 (0.100)	0.227 (0.094)
R^2	0.300 (0.170)	0.398 (0.173)	0.404 (0.168)

Notes: All variables are as defined in Table 1. Values were obtained for the replication of 100 samples of size 40. Values in parenthesis correspond to standard deviations. Model 1 corresponds to a Model without government. Model 2 corresponds to the model with a pay-as-you-go social security system. Model 3 corresponds to a fully funded system.

[6] Notice that although the results for GGDPP (GDP gross gowth rate) are not exactly the same for the three models, the differences are not statistically significant.

Table 2 makes clear that without the presence of a government (or at least a government that does not levy distortionary taxes), inequality measured by Gi is higher, while the economic performance of the economy as a whole is substantially better.

Contrary to the conclusions arrived by Karni and Zilcha (1989) a fully funded system leads (in our setup) not only to a better economic performance but also to lower income inequality.

An important observation, is that these models predict that higher government participation may lead to lower growth rates. This conclusion differs from that of recent developments in the endogenous growth literature, but seems to be fairly consistent with our observations for Brazil and the US.

Finally, many of the "bad" fits observed in the data are present in the time series implications of this model. Consider e.g. Model 2 and contrast its results with those of the US.

An interesting extension of this model would be to specify in a more general framework the particular role of different redistributive policies in each country.

Nevertheless, the Kuznets hypothesis does not seem to have empirical nor theoretical ground. Remember that given the huge standard deviations of our estimates, they are consistent with the weak correlations observed in the data.

IV. CONCLUDING REMARKS

Within the analytical framework presented here, a pay-as-you-go system leads to a worse income inequality and economic performance. Therefore a fully funded system would be preferred. These results depend crucially on the assumptions regarding the redistributional policy that the government follows. Ours does not modify substantially the income distribution after the income tax is levied. Allowing for progressive social security transfers may modify the results obtained. Nevertheless, the proportionality embodied in δ seems to be an stylized fact of most of the social security systems.

The results obtained with Brazil and US may be regarded as partial, but most of the recent empirical literature using panel data seem to lead to basically the same results as obtained here. An interesting extension of this paper would be to open the economies and look for the time series implications of the theoretical model as compared with panel data results.

In the recent years, many empirical efforts were pursued to try to test the Kuznets hypothesis, generally with mixed results. Our theoretical model may give a reason why. The

relationship between income distribution and level of income is simultaneous, there is no a priori reason to believe that one is exogenous (in the econometric and theoretical sense) to the other. The relationship builds upon complex interactions with fiscal policy and the distribution of abilities of the population.

Given our results, it seems fairly safe to conclude that the Kuznets curve may have **any** arbitrary shape at the theoretical level, and the inverted U shape is only one compatible with a particular realization of fiscal policies.

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