Transmission Mechanisms of the Inequality-Growth Relationship

Jorge A. Charles-Coll

Facultad de Comercio y Administración de Tampico, Universidad Autónoma de Tamaulipas
Centro Universitario Tampico-Madero, C.P. 89000, Tampico, Tamaulipas, México

Abstract— **This paper contributes to the debate over the relationship between income inequality and economic growth by developing a comprehensive description of the mechanisms and the models proposed in the literature over the last two decades that try to explain the way in which income distribution can influence economic performance trough economic, social and political channels.**

Keywords— **Income inequality, economic growth, political economy, wealth effect, socio-political instability, human capital.**

I. INTRODUCTION

The possibility of reaching a general consensus in the debate over the "real" effects of inequality on growth should be seen as the first step towards a complete understanding of this phenomenon. Assuming that we could reach a solution for the sign of the relationship we would still be short of reaching a level of understanding of the specific mechanisms which detonate the effects. This is why the most transcendent contributions of this debate, apart from the discussion over the sign and significance of the relationship, are the propositions and understanding of the specific channels by which inequality affects growth. It is from them where policy recommendations will emanate in order to enhance economic growth. Nevertheless, if we are far from reaching a consensus over the sign of the relationship, we are even farther from understanding the transfer mechanisms.

Even within each of the proposed relationships (negative, positive and non-linear) there is no general agreement on how does the fact of having an unequal distribution of income result in lower GDP growth after a period of time. While some authors focus only on the general sign of the relationship and pay no attention to the way it works, there have been others who have put forward some arguments that try to explain the transmission mechanism of the effect of inequality over growth.

As seen in the previous section, there have been a number of proposed mechanisms to explain the way in which inequality affects growth. There are four mainstream mechanisms that try to explain both the sign and the path through which inequality exerts its influence over growth:

- The political economy arguments
- The Wealth effect mechanism
- The Socio-political instability channel
- The Fertility-Human capital mechanism

In some cases, the empirical studies tested for one or more of this mechanisms and used them as a guideline for their model specification, in other studies, after estimating for the effect and finding the sign and assessing its effects and significance, a mechanism was adopted as a probable cause for the encountered effects. In any case, there is a general recognition that within the relationship there is one or more sequence of events in which economic variables are affected by the inequality phenomenon before it finally affects GDP growth.

Seen from a general economic perspective, the effects of inequality should necessarily be transferred through aggregate demand or supply. In this sense, most of the mechanisms yield supply side effects, mainly through the effects on investment and productivity determinants such as human capital or fertility rates. Only some alternative interpretations of the political economy arguments (the ones which do account for the beneficial effects of some redistributive policies), as well as other alternative views for the effects on human capital and its effects on wages and consumption could have demand side effects. Nonetheless, these alternative views are seldom adopted.

In the following section, the four mainstream mechanisms are described in order to understand in a more specific way the economic forces that may be working within the overall inequality and growth relationship.

II. THE POLITICAL ECONOMY ARGUMENT

The political economy arguments are by far the most frequently used in inequality-growth research. Chronologically it was also one of the first employed to justify the negative relationship between inequality and growth, and the most representative set of propositions in the conventional consensus view.

This mechanism is based on the pioneer paper of Meltzer and Richard (1981), who develop a general equilibrium model in which the size of government is determined by the median

voter, and where the activities performed by the government are redistribution and tax revenue. Here the median voter is the one who determines election outcomes. Voters with income below the median level will prefer higher taxes and more redistribution, and voters situated above the median income level will prefer lower taxes and less redistribution. This way, when average per capita income rises relative to the median voters income, taxes will tend to elevate and vice versa.

The basic idea is that these arguments occur in an economy where growth and policy are endogenously determined and related. Redistributive policy decisions are taken through voting processes. Redistribution occurs in such a way that, as average income grows, the tax rate proportionally increases but the benefits of redistribution do not, in other words, progressive redistribution takes place in this economy. Accordingly, in a country with high inequality levels, where the income of the median voter is lower than the average voter income, there will be a stronger popular support for the approval and implementation of redistributive policies, financed by higher capital taxation. At the same time, the higher redistribution will generate economic distortions in the form of less savings, erroneous expectations, time loss in political bargaining, incomplete returns from investment, among other effects that will negatively influence economic performance and thus GDP growth. The result is that higher inequality is growth detrimental, derived from the associated redistribution and its effects on investment. Notice however, that the mechanism does not explicitly say that the rich would benefit from inequality otherwise.

The following are the main assumptions of this mechanism:

- *A democratic system.* The argument excludes political systems in which political decisions are not taken through the voting process.

- *A progressive tax system.* The tax structure is constituted in such a way that individuals with higher income levels pay proportionally more taxes than those with lower income. This is also known as vertical and horizontal tax justice principle.

- *Homogeneous distribution of political power.* The one man, one vote is the rule and political power is homogeneously distributed among the population. There are no groups or individuals who accumulate higher than proportional political power.

- *Efficiency and equality are mutually exclusive.* There is a tradeoff between the objectives of the working class who want a better income distribution and the objectives of the capitalists who want more efficiency and productivity. "Economic growth and welfare do not go hand in hand" (Alesina and Rodrik, 1994).

As seen in the previous chapter, one of the first exponents of the political economy argument are Persson and Tabellini (1994), whose two period, overlapping generations model with economic and political equilibrium, allow them to forecast economic performance according to structural circumstances, initial values and, more importantly, political conditions, determined by the distribution of income and according to the income level of the median voter. As in most political economy models, the structure of the income distribution affects directly the income level of the voters situated at the median of the income distribution and who are, according to the Meltzer-Richard Hypothesis, the decisive voters, and consequently the ones who will determine, in a democratic framework, the policy decisions.

Other supporters for this mechanism are Alesina and Rodrik (1994), who take the political economy arguments further and include the possibility of a politically exogenous determination of redistribution levels and tax rates trough non democratic political systems. Among their conclusions they propose two possible paths for optimizing the efficiency-equality tradeoff:

a) A policy of tax fluctuations in which, initially, taxes on capital are increased in order to promote distribution and welfare, and afterwards they are reduced with the purpose of generating economic growth.

b) A conciliatory policy, in which moderate tax rates are defined in order to both generate growth and welfare, although both at sub-optimal levels.

Benabou (1997) introduced an ambiguity to the standard political economy model by combining it with arguments from the wealth effect mechanism, in which loan markets are underdeveloped and fail to allocate capital to every potentially productive activity, specifically to those by individuals below a certain income level (known as the minimum income trap). This addition to the redistribution/taxation tradeoff generates a situation in which as inequality increases and the median voter income falls, redistributive policy will be supported by the decisive voters, generating, on the one side, the negative economic effects proposed by the political economy arguments, and on the other, positive economic effects derived from having (as redistribution increases) a bigger amount of the population above the minimum income trap and able to access to loans for investment.

Banerjee and Duflo (2003) apply the political economy arguments to his model in order to explain his proposition that absolute changes in inequality levels affect negatively economic growth. Here the detonators of the negative relationship are the distortions generated by political bargaining for increases or reductions in tax rates and redistribution. In this model the emphasis is not on the policy outcome itself, but on the inefficiencies generated in the

process of reaching it. It could be seen as a mechanism embedded within the political economy argument.

The previous are some of the different applications of the political economy arguments to models explaining the linkage between inequality and growth. The following is a reduced form description of the basic political economy model, based on Benabou (1997).

It is a model of overlapping generations with two periods and families with non-altruistic preferences and with two periods in life, indicated as $i \in [0,1]$. The utility function and the production function are as follows:

$$U_t^i = \ln c_t^i + \rho \ln d_t^i \qquad (1.1)$$

$$y_t^i = r\left(k_t^i\right)^{\alpha}(\omega_t)^{1-\alpha} \qquad (1.2)$$

Where c_t^i represents consumption in the first period and d_t^i in the second period. Each individual is born with a basic stock of resources ω_t^i which can also be interpreted as a basic stock of human capital, distributed among all individuals with mean $\omega_t \equiv E[\omega_t^i]$, and individuals can invest either in human or physical capital. The Cobb-Douglas type production function ensures constant returns to scale. r is a constant and β has a value bigger than cero and equal or lower than 1 ($0 < \beta \leq 1$). k_t^i is the proportion of income invested in period i in time t, and y_t^i is the pre tax income of the second period.

In this economy, individuals can borrow and lend at an endogenously fixed interest rate $\tilde{r}$ and the amount borrowed by any i individual is represented by $b^i \gtrless 0$. There is also a government who redistributes second period income at a rate τ, where $\tau \geq -\sqrt{1 + 1/\rho\alpha} \equiv \underline{\tau}$. Post tax and transfer income is as follows:

$$\hat{y}^i = (y^i)^{1}-\tau(\tilde{y})^{\delta}, \qquad (1.3)$$

And the following balanced budget constraint defines the break-even income level $\tilde{y}$:

$$\int_0^1 (y^i)^{1-\delta}(\tilde{y})^{\delta}\, di = \int_0^1 y^i\, di \equiv y \qquad (1.4)$$

Given a certain redistribution rate, the maximization problem of any i individual is:

$$\max_{b^i k^i} \left\{ In\left(\omega^i + b^i - k^i\right) + \rho\, In\left[(r(k^i)^{\alpha}\omega^{1-\alpha})^{1-\tau}(\tilde{y})^{\tau} - \tilde{r}b_i\right]\right\} \qquad (1.5)$$

With first order conditions as follows:

$$d^i/c^i = \rho\tilde{r} = \rho\alpha(1-\tau)(\hat{y}^i/k^i) \qquad (1.6)$$

With an implication for the second one in the sense that everyone invests the same amount, $k^i = k$, therefore:

$$\hat{y}^i = y^i = rk^{\alpha}\omega^{1-\alpha} = y = \tilde{y}, \text{ and} \qquad (1.7)$$
$$\tilde{r} = r\alpha(1-\tau)(\omega/k)^{1-\alpha} \qquad (1.8)$$

The first Euler equation then becomes:

$$r\, k^{\alpha}\, \omega^{1-\alpha} - \tilde{r}b^i = \rho r\, \alpha(1-\tau)(\omega\,/\,k)^{1-\alpha}\,(\omega^i + b^i + k) \qquad (1.9)$$

Using the loan market clearing conditions $\int_0^1 b^i\, di = 0$ and summing over agents we get the following:

$$k = \frac{\rho\alpha(1-\tau)\omega}{1+\rho\alpha(1-\tau)} \equiv \delta(\tau)\omega \qquad (1.10)$$

In this economy, the main feature of redistribution is its implementation via the appropriation of a proportion of the returns to investment. This has repercussion in the following growth rate of income as it declines with the tax rate τ.

$$g(\tau) \equiv \ln(y\hat{u}) = \ln r + \alpha \ln\delta(\tau) \qquad (1.11)$$

In order to understand the intergenerational effects of the model and the long run implication for growth rates it is necessary to introduce the dynamic linkages of the setting. In this case, Benabou (1997) takes the idea of Persson and Tabellini (1994) of introducing an aggregate spillover by which some of the productivity of a generation is transmitted to the next one $t + 1$ in the form of a basic stock of human capital:

$$\omega_{t+1}^i = \epsilon_{t+1}^i y_t \qquad (1.12)$$

Where ϵ_t^i is and i.i.d shock with mean normalized to 1. Additionally, parents devote some of their second period resources to children education. This way, individuals would care about second period consumption (c_t^{ji}) and the provision of human capital of their children:

$$U_t^i = \ln c_t^i + \rho\gamma \ln c_t^{ji} + \rho(1-\gamma)E_t[\ln \omega_{t+1}^i] \qquad (1.13)$$

Being ω_{t+1}^i a combination of personal abilities and public expenditure on education, financed by a tax on second period income,

$$\omega_{t+1}^i = K\,\epsilon_{t+1}^i e_t \qquad (1.14)$$

With logarithmic preferences, the unanimously preferred tax rate is $1 - \gamma$, so that $c_t^{ji} = \gamma d_t^i$ and $e_t = (1-\gamma)d_t = (1-\gamma)y_t$. Additionally, $\omega_{t+1}^i = k(1-\gamma)\epsilon_{t+1}^i y_t$, and normalizing the constant to one we have that the inter- and intra-generational growth rates are equal:

$$gt = ln\,(y_t/y_{t-1}) = ln(\omega_{t+1}/\omega_t) = ln(y_t/\omega_t) = ln\,r + \alpha ln\,\delta(\tau_t) \qquad (1.15)$$

Where τ_t is the tax rate chosen in generation *t*.

We now follow to the way equilibrium tax rates are determined in an economy. Remember that each individual will decide to invest either in human or physical capital according to the production function and a given interest rate. From this follows that for a given optimal investment of individual i, the necessary borrowing is the following:

$$b^i = \frac{\rho}{1+\rho}(\omega - \omega^i) \qquad (1.16)$$

And the corresponding interest rate is:

$$\tilde{r} = r\alpha(1-\tau)^\alpha(1+\rho\alpha(1-\tau))^{1-\alpha} \qquad (1.17)$$

As mentioned before, redistribution occurs financed by the tax rate τ. This tax lowers the equilibrium return on investment, benefiting borrowers and affecting lenders. Thus the representative agent, who does not make use of the loan markets, is left unaffected. Given optimal borrowing and investment decisions, the intertemporal utility of individuals is the following:

$$U^i(\tau) = V(\tau) + (1+\rho)ln\,[1 + (\omega^i/\omega - 1)(1+\rho\alpha(1-\tau))/(1+\rho)] \qquad (1.18)$$

where:

$$V(\tau) \equiv (1+\rho)ln\,\omega + ln\left(1-\delta(\tau)\right) + \rho\,ln\,(r\delta(\tau)^\alpha) = ln\,c + \rho\,ln\,d \qquad (1.19)$$

A social planner's preference would be concerned only with the intertemporal efficiency and will be indifferent to the distribution of consumption across individuals. Since

$$V'(\tau) = -\frac{\rho\alpha\tau}{(1-\tau)(1+\rho\alpha(1-\tau))} \qquad (1.20)$$

The social planner's (as well as the representative individual with average endowment of ω) preferred tax rate, will be zero. An important implication of this is the fact that individuals with incomes lower than the average will prefer progressive taxes, as they will maximize their utility at a positive tax rate in which $U^i(\tau) = 0$ or:

$$\varphi(\tau) \equiv \frac{\tau(1+\rho)}{(1+\rho(1-\tau))(1+\rho\alpha(1-\tau))} = 1 - \frac{\omega^i}{\omega} \qquad (1.21)$$

Thus for this type of individual, its preferred tax rate declines with his income. For individuals with income levels above the average the problem is that φ is non monotonic over all negative values of τ. It can be shown that $U^i(\tau)$ remains strictly concave in its domain $[\underline{\tau}, 1]$, where $\underline{\tau} < -1$ was previously defined. For $\omega^i/\omega < 1 - \varphi(\underline{\tau})$ agents i's preferred tax rate will be given by the previously described first order condition, for richer individuals $\tau^i = \underline{\tau}$ is the corner solution.

Finally, in his model, Benabou (1997) assumes (again based in Persson and Tabellini, 1994) that $\overline{\tau}$ is chosen permanently in the first period. And the political process is determined by the majority voting, and the median voter is determinant in the determination of any single tax rate, thus the implications of the income distribution in the determination of such tax. Accordingly, if the distribution is such that the median voter has an income level below the median, then the choice of tax rate will be higher and the growth rate will be lower.

III. THE WEALTH EFFECT ARGUMENT

The core idea of this mechanism is to explain the negative effects of income inequality on growth, trough the assumption of imperfect credit markets. It does so by assuming that, in a country with a high rate of inequality, potentially productive activities are restricted for individuals in the lower income brackets of the distribution due to the impossibility for them to access credit and acquire the necessary initial capital for investment. This failure of the loan markets to assign capital to any potentially productive activity (in the form of productive investments or enhancers such as human capital investment) to entrepreneurs with low income levels generates a minimum income trap for the low income population which hampers economic performance. In other words, as inequality rises and a bigger proportion of individuals are situated below the minimum income trap, less investment and growth will occur. Accordingly, redistributive policies that translate more individuals with incomes above the minimum required into access to the loans market will result in higher investment and growth in the short and long run.

This mechanism works under the following main assumptions:

- Imperfect or underdeveloped credit markets.
- The existence of a minimum income trap for the access to credit.
- A concave relationship between current and future wealth.

We can use the above described model based on Benabou (1997), to depict the implications of the wealth effect arguments in the inequality-growth relationship. Here agents are impeded to borrow from each other due to the existence of moral hazard, therefore, the optimization problem of individual i is the same as (1.5) except that bi is now constrained to cero:

$$\max_{k^i}\{ln(\omega^i - k^i) + \rho ln\,(r[(k^i)^{1-\tau}(\tilde{k}^\tau)^\alpha\omega^{1-\alpha})\} \qquad (2.1)$$

Being the optimal investment as follows:

$$k^i = \frac{\rho\alpha(1-\tau)\omega^i}{1+\rho\alpha(1-\tau)} = \delta(\tau)\omega^i \qquad (2.2)$$

Were all individuals invested previously a portion δ of aggregate income; they now invest the same amount of their individual income. The following balance budget of the government defines $\tilde{k}$ to be $\tilde{k} = \delta\tilde{\omega}$,

$$\int_0^1 (k^i)^{1-\tau}(\tilde{k})^\tau di = \int_0^1 k^i di \qquad (2.3)$$

With

$$(\tilde{\omega}/\omega)^\tau \equiv \omega^{1-\tau}/E[(\omega^i)^{1-\tau}] \qquad (2.4)$$

Resulting in a second period income of:

$$y^i = r\delta^\alpha(\omega^i)^{\alpha(1-\tau)}\tilde{\omega}^{\alpha\tau}\omega^{1-\alpha} \qquad (2.5)$$

With a growth rate of aggregate income of the form:

$$g(\tau) \equiv \ln(y/\omega) =$$
$$\ln r + \alpha \ln\delta(\tau) - \ln\big(E[(\omega^i)^{1-\tau}])^\alpha/E[(\omega^i)^{\alpha(1-\tau)}]\big) \qquad (2.6)$$

And with the dynamic relation previously specified (1.12-1.15), the following intergenerational growth rate:

$$g(\tau_t) = \ln(\omega_{t+1}/\omega_t) = \ln(y_t/y_{t-1}) \qquad (2.7)$$

The last term is negative for $\beta < 1$ due to Jensen's inequality, and it disappears for a value of $\beta = 1$. A more unequal income and resource distribution will increase the loss and will affect growth rates. If we assume the initial endowment of individuals to be distributes log-normally $ln\omega^i \sim N(m, \Delta^2)$ we obtain the following growth expression:

$$g(\tau) = lnr + \alpha ln\delta(\tau) - \alpha(1-\alpha)(1-\tau)^2 \Delta^2/2 \qquad (2.8)$$

With imperfect financial markets and $\alpha < 1$, agents face decreasing returns to their investments and progressive redistribution allow individuals in the lowest income levels to access higher returns and diminishes the negative effects of the credit constraints. Redistribution is assumed to be carried out in the form of net transfers, reducing the incentives to save. The objective function of a social planner with no distributional interests is the following, when evaluating intertemporal efficiency:

$$W(\tau) \equiv lnc + \rho lnd = V(\tau) - \rho\alpha(1-\alpha)(1-\tau)^2 \Delta^2/2 \qquad (2.9)$$

From above Benabou (1997) confirms that at any tax rate, inequality affects negatively economic growth and intertemporal efficiency.

Among the first ones to apply the wealth effect arguments to the inequality-growth relationship are Galor and Zeira (1993) who provided what for them was a plausible explanation for the differences in per capita GDP across countries. These differences were explained by the effects of output and investment of the different income distributions across countries in the presence of credit market underdevelopment. Their focus was mainly on the effects of inequality over human capital investment (thus the long term implications of the model). In the development of their overlapping generations model they found that a given income distribution, an initial general income level and the existence of credit market imperfections will determine which of the multiple steady states will the economy reach. Due to the nature of the model, the inequality-human capital-growth relation will have intergenerational effects and will influence the allocation of the individuals across economic sectors.

Aghion and Bolton (1997) argued in the same line but with some additional features such as trickle down properties of growth to inequality levels, the assumption of inequality being partially determined by the lack of insurance by entrepreneurs against the risk generated by the randomness of the returns to investment projects, as well as moral hazard as the source for both the imperfections is the loan markets and the "persistent" levels of income inequality.

The authors argument in favour of redistributive policy an affirm that even though the economy will naturally reach a unique steady state income distribution, government intervention can potentially enhance the trickle down mechanism and increase, through redistribution, the productive efficiency of the economy.

Another theoretical model in which the wealth effect arguments are introduced is Banerjee and Newman (1993). The authors explain the dynamics of the occupational choices as a function of the income distribution and conditional to the existence of capital market imperfections. The basic idea is that in an economy with imperfect capital markets, the lower income population will not be able to invest and they will choose to be employed. Contrastingly, the population in the high income end of the distribution will have access to credit and will choose to become entrepreneurs and employ the share of the population who chose to be employed.

According to the authors, this tendency in occupational determination, influenced by the income distribution, is the one responsible for the long term differences in the development patterns (and levels) and the economic structure among many countries. Here, as in Aghion and Bolton (1997), the assumption of an equilibrium rate of income distribution is latent in the model, in this case, the affirmation that "Only with sufficient inequality, however, will there be employment contracts; otherwise, there is either subsistence or self-employment", implies that even if the economy has sufficient income levels to promote the entrepreneurial path, there is a need for certain income inequality to ensure the necessary employees for the development of the economic dynamics. Notice that in this model the role of redistribution is included

as a variable affecting economic growth and inequality is tacitly accepted as exogenous.

Barro (2000) links the effects of income inequality non linearly to economic growth as a function of the general income level of the economy, under the assumption of a positive relationship between income levels and financial market development, the effects of redistributive policies will work simultaneously in two directions: first, allowing economic agents to overcome the minimum income trap for investment and the generation of productive activities otherwise impossible; and second, promoting the development of the financial markets and the correction of the inefficiencies in credit allocation. All of the previous will result in higher growth rates.

As mentioned before, the model developed by Benabou (1997) is a reference in the inequality-growth debate. In their model, the authors combine political economy arguments with the wealth effect mechanism and reach ambiguous conclusions over the effects of redistribution on inequality and on growth. The duality of effects come from the fact that as inequality rises, tax rates and redistribution are incremented as well, according to the new political equilibrium, and the economy grows at a lower rate. But as the redistributive actions increase the incomes of the poorest share of the population, a proportion of them who could not access credit will now surpass the minimum income trap and carry out productive investment, thus favouring economic growth.

The previous is an example of some of the ambiguities found when combining two of the proposed transmission mechanisms for the inequality-growth relationship. Other type of considerations are the promoting activities of development banks in allocating credit or performing as guarantee for loan takers, or the widely disseminated and publicly financed micro credits, which have allowed, especially in developing countries, millions of persons to overpass the income traps for investment in productive activities and to neutralize the potential effects of imperfect financial markets.

IV. THE SOCIO-POLITICAL INSTABILITY MECHANISM

Although less influential than the previous two arguments, this mechanism is one of the most straightforward propositions, and perhaps the one with the most realistic assumptions. It supports a negative relationship between inequality and economic growth based on arguments about the negative effects of inequality over social behaviour and the economic consequences derived from this condition. It is assumed that in a country with high inequality levels, there will be a considerable amount of social discontent by those affected by this scenario. The result is that this share of the population will manifest their discontent by incurring in illegal activities such as public disturbances, protests, riots,

revolutionary movements, coups d'états, as well as other expressions of illegal appropriation such as crime, corruption activities or the generation of other "public bads". The result is a scenario of instability and uncertainty in which private property as well as institutions and the rule of law are weakened. Capital owners in this economy will have to protect their investments from the predatory activities in order to ensure the expected returns. This means that capital otherwise intended for future investment will have to be allocated into the protection of the previously undertaken enterprises, therefore lowering the aggregate levels of investment and exerting negative effects on economic growth. Additionally, this situation sends a negative sign to the world and lowers the amount of foreign direct investment entering the economy, further affecting growth.

The previously described scenario generates two circumstances that simultaneously distress the economic potential: first, derived from the consequences of social discontent over stability, security and other variables that negatively affect growth; and second, from the necessary waste of resources for the protection of current investments.

The main assumptions of this mechanism are basically two: first, a positive relationship between inequality and social discontent; and, second a negative relationship between inequality and democratic development, which implies the absence of a developed democratic system to canalize the social discontent through redistributive decisions.

The most influential studies in this line of taught are the ones of Alesina and Perotti, (1996); Perotti (1993 and 1996) and Benabou (1997). They combine in their theoretical models, both strands of instability measurement: the ones measuring political and social conflicts, and the indicators of the levels of property rights, in order to control for a broader measure for socio-political instability and measure its effects on economic performance.

Even though there are previous studies who found a negative link between social and political instability (Alesina and Perotti, 1996; Barro, 1991), they do not explicitly acknowledge the effects of inequality in the relationship. Alesina and Perotti (1996) are among the first ones to test for the effects. In their empirical study they tested first for the positive relationship between income inequality and socio-political instability with a sample of 70 countries over 25 years. The authors developed an index of socio-political instability constituted by the following elements:

1. An index composed by variables such as number of protests, homicides, coups d'états and revolutions.
2. Measures of changes in the government, estimations over the probability of changes in key government staff, among others.

The results evidenced the highly significant correlations between the variables, finding that when the middle class experiences an increase in their income share, this in turn reflects in a considerable increase in political stability, as well as in the investment rates.

The issue about the proper way to measure instability is also one to take into account. In contrast to Alesina and Perotti (1996), some authors emphasize more on other forms of instability such as the ones related to property rights, the stability of the public sector in terms of complying with its obligations and protecting the interests of the capitalist, the enforceability of contracts, and other forms of security guaranties and property rights. However, one must be careful and aware of the correlation and causality between some of these measures of instability. Svensson (1998) noticed that when controlling for both property rights and political instability, the second one turns to be statistically insignificant after being significant when included alone, the reason is that the first one captured the effects of the second due to the fact that the existence of political instability implies the weakening of property rights.

One might see the instability channel as an anti-political economy mechanism, one in which redistribution, in the absence of a political equilibrium to generate it, occurs by means of an illegal appropriation of property. Nevertheless, this does not mean that redistribution will be progressive or homogeneous. In this context of deficient rule of law it is also plausible to argue that people in the higher income brackets could be on a better position than to appropriate of the property of others, or that those individuals could take from the population in the lower brackets of the income distribution due to their vulnerability.

V. THE FERTILITY-HUMAN CAPITAL MECHANISM

The following is the fourth and last mainstream mechanism found in related literature that tries to explain the way inequality affects growth, and it does so in accordance to the proposition of a negative overall relationship between them.

The framework is an economy where both the fertility levels and the decisions over the amount of education provided to children are endogenous. Therefore, there is a tradeoff between the amount of children individuals decide to have and the education they wish to provide them. Inequality plays a key role here in the determination of the fertility rates across the different income levels. Individuals with a higher income level will prefer to have fewer children and they will be able to provide them with high levels of education. Accordingly, a couple in the lowest income bracket will decide to have more children and provide them with low or null levels of education. The argument is that for the rich, opportunity costs of having more children are higher than for

the poor. These opportunity costs are associated to the necessary time to be allocated to each child in relation to its allocation in productive activities. In other words, time is more valuable for rich individuals and therefore having more children who need time, means earning less. For that reason, given that for the poor individual the opportunity costs of having children are lower, they decide to have more.

This situation creates fertility differentials between individuals in different income levels which, in combination with the negative relationship between income level and education, generate an aggregate reduction in the stock of human capital in the economy, thus negatively affecting productivity levels and economic performance.

According to the mechanism, this inequality-fertility differentials-stock of human capital-economic growth relationship explains the differences in long run development patterns of countries with different income distributions.

The main assumptions of this mechanism are the following:

- Fertility rates are negatively correlated to the income level.
- Children require both time and money from both parents in their education.
- Educational attainment and, consequently, human capital is positively related to the parents income level.
- Parents face a tradeoff between quantity and quality in their fertility and education decisions.

One of the most relevant implications is that it does not imply necessarily that redistributive policy is the only way to reverse the negative effects of inequality over growth rates. A policy intended to reverse any of the intermediate effects of income inequality could also provide growth enhancing results. A comprehensive public education system, available for individuals in the lowest income groups, could not only reverse the decrease in aggregate human capital and growth but it could even boost it.

As mentioned before, De la Croix and Doepke (2003) can be considered as the main proposers of this mechanism. However, we can see their arguments as the conjunction of two inequality related relationships, the negative link between income inequality and fertility rates, as well as the negative correlation between fertility and human capital accumulation, previously studied other authors (Eicher and Gracía-Peñalosa, 2001; Kremer and Chen, 2002; Viaene and Zilcha, 2003; Castelló and Doménech, 2002). In their empirical study they found that for their cross section of 68 countries, the ones with the highest inequality will also have biggest fertility differentials and lower educational attainment. Moreover, they found that "an increase in the fertility differential from one to two would lower growth by 0.8% per year" (De la Croix and Doepke, 2003).

Regarding their empirical estimations, it is important to point that due to the nature of the mechanism, each period corresponds to a generation; therefore this model predicts the effects of inequality over growth in the medium and long term, in fact, De la Croix and Doepke affirm that their model can explain the joint evolution (for most developed countries) of income distribution, fertility differentials and economic growth over the last 200 years.

Ahituv and Moav (2003) propose the existence of "fertility clubs", and show with a theoretical model of overlapped generations, that different levels of education of parents derive into two steady states in the growth transition of the economy. According to the model, a country with high inequality and low educational attainment will finally converge into a "low" steady state, characterized by having a poverty trap in which there will be high fertility rates and low growth. According to the authors, the duality in the steady state comes from the effect of parent educational levels over the opportunity cost of children. The lower the educational level of the parents, lower will be the opportunity cost of educating their children and thus having children will be relatively cheaper for them and they will choose to have more children.

The authors provide an additional conclusion in the sense that education, and specifically the educational level of the mother can generate a reduction in fertility levels as well as an increase in overall economic performance. Additionally, they confirm (De la Croix and Doepke, 2003; Kremer and Chen, 2002; Viaene and Zilcha, 2003) the findings leading to conclude that the high fertility rates in developing countries or in low income population in highly unequal countries is responsible for reducing the growth rate through its effects over human capital accumulation.

The following model (based in De la Croix and Doepke, 2003), depicts the fertility-human capital framework. It is embedded in an overlapping generations model with three periods and altruism characteristics. Decisions about resources allocation are taken in the second period of life, and the utility function of any i individual is defined by:

$$U_t^i = \ln(c_t) + \beta \ln(d_{t+1}) + \gamma \ln(n_t h_{t+1}) \qquad (3.1)$$

Where c_t is consumption in the second period, d_{t+1} is consumption in the third period, n_t is the number of children and h_{t+1} is the human capital of those children. In the time horizon of an individual, the first period corresponds to childhood, second period to adulthood and third period to old age. β is a positive parameter which represents a psychological discount factor and γ is also strictly positive and represents altruism among generations. $\beta > 0, \gamma > 0$.

Individuals must choose during their life time, consumption levels for the second and third period, as well as savings s_t, number of children n_t, as well as education provision for each child e_t. The budget constrain for the third period individuals is the following:

$$d_{t+1} = R_{t+1} s_t \qquad (3.2)$$

Which is determined by the savings in the second period and the interest rate R_{t+1}.

Each child requires allocation of time by the parents represented by $\phi \in (0,1)$. Additionally, it is assumed that the average human capital is the same for teachers as for the whole population, this way, the cost per family of educating their children is $e_t n_t w_t \bar{h}_t$, from this and the notation of w_t as the wage per unit of human capital we get the following budget constrain:

$$c_t + s_t + e_t n_t w_t \bar{h}_t = w_t h_t (1 - \phi n_t) \qquad (3.3)$$

De la Croix and Doepke (2003) affirm that the assumption that formal education is provided by teachers is fundamental for generating the fertility differentials due to the fact that it implies educational costs to be fixed and independent from the wage level of the parents. This implies two key features: First, that the income level matters for the provision of education, a poorer family will find educational costs to be relatively more expensive than rich families; Second, that a rich family will incur in higher opportunity costs of raising children, because each child requires a fix amount of time, so more children imply higher opportunity costs. From this comes the assumption that high income families will choose to have less children and will be able to educate them more, the opposite happens in poor families who will choose to have more children (as their opportunity costs are lower due to their lower wages) and educate them less. Education of children (first period) is provided exclusively from parents (second period).

The human capital of children is determined by the average human capital $\bar{h}_t$, the human capital of the parents h_t and from the provided education e_t, so that:

$$h_{t+1} = B_t (\theta + e_t)^\eta (h_t)^\tau (\bar{h}_t)^k \qquad (3.4)$$

Where the parameter $\tau \in [0,1]$ represents the transmission of human capital from one generation to the other; $k \in [0, 1 - \tau]$ captures social externalities such as the quality of the school system; $\eta \in (0,1)$, and B_t is strictly positive and increases deterministically at the rate:

$$B_t = B(1 + \rho)^{(1 - \tau - k)t} \qquad (3.5)$$

The production function for this economy is a Cobb-Douglas function:

$$Y_t = A K_t^\alpha L_t^{1-\alpha} \qquad (3.6)$$

Where L_t is aggregate labor supply, K_t is aggregate capital and A is strictly positive and represents technology, finally $\alpha \in (0,1)$. The firm maximizes profits given:

$$Y_t - \omega_t L_t - R_t K_t \qquad (3.7)$$

Population evolves over time as follows:

$$P_{t+1} = P_t \int_0^\infty n_t \; dF_t(h_t) \qquad (3.8)$$

Human capital is distributed according to $F_t(h_t)$ and it evolves over time according to:

$$F_{t+1}(h) = \frac{P_t}{P_{t+1}} \int_0^\infty n_t \, I(h_{t+1} \le h) dF_t(h_t) \qquad (3.9)$$

Where I( ) is an indicator function. Average human capital $\bar{h}_t$ is given by:

$$\bar{h}_t = \int_0^\infty h_t \; dF_t(h_t) \qquad (3.10)$$

The market-clearing condition for capital is:

$$K_{t+1} = P_t \int_0^\infty s_t \; dF_t(h_t) \qquad (3.11)$$

And for labor:

$$L_t = P_t \left[\int_0^\infty h_t (1 - \phi n_t) \, dF_t(h_t) - \int_0^\infty e_t n_t \bar{h}_t dF_t(h_t) \right] \quad (3.12)$$

The previous setting provides the equilibrium in the depicted economy given the initial conditions in human and physical capital, population, as well as other variables. We now turn to the characterization of the conditions which allow the fertility-human capital mechanism to work, namely, the tradeoff faced by families in their decisions about number of children and the provision of education. In this sense, we define the relative human capital of a household as the relation between their specific human capital and the average in the economy, denoted as follows:

$$x_t \equiv \frac{h_t}{\bar{h}_t} \qquad (3.13)$$

For a family in which $x_t > \frac{\theta}{\phi\eta}$ holds, there is an interior solution for the optimal level of education, and the first order conditions involve:

$$s_t = \frac{\beta}{1+\beta+\gamma} \omega_t h_t \qquad (3.14)$$

$$e_t = \frac{\eta\phi x_t - \theta}{1-\eta} \qquad (3.15)$$

$$n_t = \frac{(1-\eta)\gamma x_t}{(\phi x_t - \theta)(1+\beta+\gamma)} \qquad (3.16)$$

The second order conditions for a maximum are satisfied, notice the following:

$$\frac{\partial e_t}{\partial x_t} > 0 \;\; and \;\; \frac{\partial n_t}{\partial x_t} < 0 \qquad (3.17)$$

The first one implies that the education provided to children will be higher if the human capital of the parents is also higher, and the second one says that the choice of how many children to have will be lower as the human capital of the family is higher.

The lowest fertility rate is thus described as follows:

$$\lim_{n_t \to \infty} n_t = \frac{\gamma(1-\eta)}{\phi(1+\beta+\gamma)} \qquad (3.18)$$

Additionally, for poor families with low human capital such that $x_t \le \frac{\theta}{\phi\eta}$, the choice of education to provide is zero and the first order conditions imply equation (14) and this constitutes the lower bound of the fertility education differentials:

$$e_t = 0, \qquad (3.19)$$

$$n_t = \frac{\gamma}{\phi(1+\beta+\gamma)} \qquad (3.20)$$

Fertility depends negatively from human capital, thus the upper bound on the fertility differential is depicted by:

$$\frac{\lim_{x_t \to 0} n_t}{\lim_{x_t \to \infty} n_t} = \frac{1}{1-\eta} \qquad (3.21)$$

As seen in the previous lines, once we assume that education is a linear function of relative human capital, we find that an increase in inequality of human capital will lower future average human capital due to the fact that human capital is concave in education.

Several characteristics in the fertility-human capital mechanism can be revisited in order to develop a more comprehensive explanation for the effects of income inequality over growth through the demographic structure of an economy and the stock of human capital in it. The following alternative arguments are based on Veloso (2000), and adapted to the inequality-growth debate.

The first feature to point out is the lack of discernment of the characteristics of parents in the way the mechanism works. If we take into account the fact that, in most societies, the roles of the mother and the father in raising children are different, being the first one the main responsible for the time allocation to children and the second one of the provision of

income, then the premise of seeing fertility and education decisions as a function of the whole family's time and income, instead of distinguishing between the specific amounts each parent has available for those activities. Additionally, if we also consider the fact that societies are changing and women's participation in the formal economy is steadily rising, we have even more arguments to take a closer look at the separate roles of the parents in the fertility-education decisions.

The fact that time allocation is a necessary condition for raising children, and given the assumption that the woman is the one generally responsible for that time allocation, then fertility decisions are (additionally to income levels) a function of the participation rate of women in the economy. The logic of this statement is that as the women participation rates rises the opportunity costs of having more children will be higher and the fertility rate will be lower.

Proposition No. 1. No matter the income level, if the women's economic participation rate grows, fertility rates will be reduced accordingly.

Additionally, as the choice of children is reduced because of the incorporation of women to productive activities, and, since the overall family income is increased, families will be able to provide more education that otherwise possible if they had more children and less family income.

Proposition No. 2. No matter the income level, as the rate of participation of women in the economy rises and the fertility rate decreases, the provision of education to children also increases.

Evidently, the amount of education provided to children will vary according to family income levels. Nevertheless, the feature of this here is the inclusion of two new scenarios regarding the fertility and education levels for rich and poor families. The first one is the possibility of having rich families with many children when the mother does not work and has more available time for child rising. The second is a scenario in which both parents in poor families work, and they choose to have fewer children than otherwise if the women did not work.

All of these predictions involve the generation of intergenerational cycles, according to the initial conditions. The decision of having less children will generate more educational levels, but this in turn, will strengthen the decrease in fertility rates, as the next generation will be prone to higher incomes, thus generating a, perhaps, virtuous cycle.

VI. DISCUSSION

The previous sections provide arguments to believe that the relationship between income inequality and economic growth may still be far from being understood. The very existence of a debate with three contrasting views might strengthen that idea even more. It seems that a general consensus may be distant from being reached and, even though the non linear propositions could act as a conciliatory argument, a complete

framework for understanding both the causal relationship as well as the embedded mechanisms by which the relationship takes place is still missing.

Perhaps a reformulation of the initial question might be the starting point for reaching a generalized solution; should we expect inequality to exert any single effect over economic performance?, is it acceptable to expect every level of inequality to affect growth in the same manner?, these and other questions that take us back to the starting point may lead to a new approach for this interesting and most relevant topic. The following section proposes and explores a new framework for understanding the complex relationship between income inequality and economic growth.

REFERENCES

[1]   Aghion, P., and Bolton, P. (1997). A theory of trickle-down growth and development. *Review of Economic Studies, 64*(2), 151-172.

[2]   Ahituv, A., and Moav, O. (2003). Fertility clubs and economic growth. *Inequality and Growth: Theory and Policy Implications*, 61-87.

[3]   Alesina, A., and Perotti, R. (1996). Income distribution, political instability, and investment. *European Economic Review, 40*(6), 1203-1228.

[4]   Alesina, A., and Rodrik, D. (1994). Distributive politics and economic growth. *Quarterly Journal of Economics, 109*(2), 465-490.

[5]   Banerjee, A. V., and Duflo, E. (2003). Inequality and growth: What can the data say? *Journal of Economic Growth, 8*(3), 267-299.

[6]   Banerjee, A. V., and Newman, A. F. (1993). Occupational choice and the process of development. *Journal of Political Economy, 101*(2), 274-298.

[7]   Barro, R. J. (1991). Economic growth in a cross section of countries. *Quarterly Journal of Economics, 106*(2), 407-443.

[8]   Barro, R. J. (2000). Inequality and growth in a panel of countries. *Journal of Economic Growth, 5*(1), 5-32.

[9]   Benabou, R. (1997). Inequality and Growth: National Bureau of Economic Research, Inc.

[10] Castello, A., and Domenech, R. (2002). Human capital inequality and economic growth: Some new evidence. *Economic Journal, 112*(478), 187-200.

[11] De la Croix, D., and Doepke, M. (2003). Inequality and growth: Why differential fertility matters. *American Economic Review, 93*(4), 1091-1113.

[12] Eicher, T., and Garcia-Penalosa, C. (2001). Inequality and growth: the dual role of human capital in development. *Journal of Development Economics, 66*(1), 173-197.

[13] Galor, O., and Zeira, J. (1993). Income distribution and macroeconomics. *Review of Economic Studies, 60*(1), 35-52.

[14] Kremer, M., and Chen, D. L. (2002). Income distribution dynamics with endogenous fertility, *Journal of Economic Growth, 7*(3), 227-258.

[15] Meltzer, A. H., and Richard, S. F. (1981). A Rational Theory of the Size of Government. *Journal of Political Economy, 89*(5), 914-927

[16] Perotti, R. (1993). Political equilibrium, income distribution and growth. *Review of Economic Studies, 60*(4), 755-776.

[17] Perotti, R. (1996). Growth, Income Distribution, and Democracy: What the Data Say. *Journal of Economic Growth, 1*(2), 39.

[18] Persson, T., and Tabellini, G. (1994). Is inequality harmful for growth?. *American Economic Review, 84*(3), 600-621.

[19] Public Choice 41: 403–418

[20] Svensson, J. (1998). Investment, property rights and political instability: Theory and evidence. *European Economic Review, 42*(7), 1317-1341.

[21] Veloso, F. A. (2000). Income Composition Endogenous Fertility and Schooling Investments in Children: Ibmec Working Paper, Ibmec São Paulo.

[22] Viaene, J. M. and Zilcha, I. (2003) 'Human capital formation, income inequality, and growth', *Inequality and Growth: Theory and Policy Implications*, 89-117.