Essays on inequality, redistribution and wealth-based politics.

by

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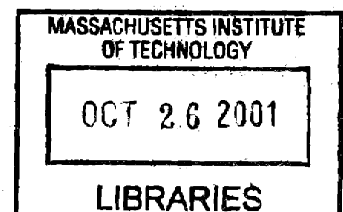Thesis Supervisor

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Abstract

This thesis is a contribution to the theory and empirics of inequality, redistribution and growth. It is divided in three chapters. Two of them study theoretical models of inequality, wealth-based politics and redistribution. The third chapter is an empirical contribution to the literature on growth and the income distribution

In the first chapter, we explore the theoretical relation between economic and political inequality and redistribution policy. Using a static model of politics in which wealth determines political power, we study the relationship between a society's level of inequality, its political system, and the redistributive policies it will choose. We explore the widely used argument that the wealthier have more political power which they can use to oppose efficient redistributions. We show that the effect of a rise in inequality on the wealth of the decisive voter does not depend on the wealth bias in the political system *per se*, but on the extent to which political power is unequally distributed *relative* to the initial level of wealth inequality. Moreover, we find that the *curvature* of the political function that links wealth to political weight determines how political power is shifted from the poor to the rich following a rise in inequality.

We illustrate these results by using three simple political mechanisms, including a widely used model of political exclusion based on wealth. We show that, contrary to the usual argument, societies where political participation is limited to a small wealthy elite are more subject to redistributive pressures when their level of inequality increases, compared to less exclusive societies. We use specific historical examples to support the implications of the model.

The second chapter extends the model presented in chapter one to a two-period framework. The idea is to model how the prospect of *future* distributional conflicts affect present choices of redistribution and political reform when wealth gives political power. The aim of the model is to shed some light on the incentives of the politically powerful to pursue distributional policies that can be growth enhancing, when these policies adversely affect their future political weight. We illustrate this dynamic distributional conflict using two simple models of political power, where political weight depend on wealth or on rank in the income distribution. We show that the *more* wealth-biased the political system, the *lower* will be the redistribution rate in period 1, as the future political cost of redistributing is higher. We also provide some insights on how these dynamics behave when considering a more

general form of political system. Finally, we introduce political change into the framework and present a model of franchise extension and redistribution that entails a risk of revolution. We find that when political weight is based on wealth, then an elite which chooses not to extend the franchise early, will choose a *higher* rate of redistribution, the *higher* the probability of a revolution occurring in period 2. The idea being that in a wealth-based political system, the expected future political cost of redistributing income in the first period is *lower*, the higher the probability that a revolution abolishes this wealth-based system.

The third chapter is based on joint work with Marwan Elkhoury[1]. It is a contribution to the literature on the effect of growth on income distribution. We use an extended version of Dollar-Kraay [2000] dataset and show that growth affects the income distribution unevenly. We first reproduce their finding that the income share of the first quintile is unaffected by growth, and find that it is also the case for the second quintile. We then apply the same analysis to other parts of the income distribution and find that growth *improves* the *income share* of the middle portion of the income distribution (third and fourth quintiles) while it *reduces* the *income share* of the upper quintile of the population. Consistent with this result, we find that the Gini coefficient is negatively related to growth. One possible explanation of these findings is that redistribution is disproportionally benefiting the middle classes, so that their share of income might actually raise with growth. We indeed find that, controlling for average income, the income shares of the third and fourth quintiles *increase* with two measures of redistribution (government consumption, and social expenditures), the income share of the top quintile *decreases* with redistribution, while the income shares of the first and second quintiles are not affected by redistribution. Education expenditures have an equal (possibly null) effect on all parts of the income distribution.

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Acknowledgments

Chapter 1

Inequality, Redistribution and Wealth-based Politics.

1.1 Abstract

Using a static model of politics in which wealth determines political power, we study the relationship between a society's level of inequality, its political system, and the redistributive policies it will choose. We explore the widely used argument that the wealthier have more political power which they can use to oppose efficient redistributions. We show that the effect of a rise in inequality on the wealth of the decisive voter does not depend on the wealth bias in the political system *per se*, but on the extent to which political power is unequally distributed *relative* to the initial level of wealth inequality. Moreover, we find that the *curvature* of the political function that links wealth to political weight determines how political power is shifted from the poor to the rich following a rise in inequality.

We illustrate these results by using three simple political mechanisms, including a widely used model of political exclusion based on wealth. We show that, contrary to the usual argument, societies where political participation is limited to a small wealthy elite are more subject to redistributive pressures when their level of inequality increases, compared to less exclusive societies. We use specific historical examples to support the implications of the model.

"To determine the laws which regulate this distribution is

the principal problem in political economy" David Ricardo 1819.

1.2 Introduction

Why do some societies redistribute more, or in a better way, than others ? What determines the type of redistributive mechanisms and the size of the welfare states that we observe across time and regions ? These fundamental questions remain largely unanswered. Theoretical and empirical research has concentrated on explaining the sources, costs and benefits of inequality, while little is known on how societies choose their redistributive policies, or how these choices are affected by the level of economic development and the extent of political and economic inequalities. There are basically two ways to approach these issues. The first one is a public finance approach. Given their economic structure, societies weight the incentive costs and the economic benefits of redistributing wealth, and consequently choose a tax scheme that maximizes some welfare function. The second one is a political economy approach. It assumes that the choice of a redistributive policy is the outcome of a distributional conflict among agents who bear differently the economic costs and benefits of redistributing wealth. The initial levels of political and economic inequalities therefore interact to determine the amount of redistribution. This chapter fits in that second literature and tries to shed some light on the relation between the distribution of income and the redistributive policy adopted when wealth affects individual political power.

Understanding the relation between wealth-based politics, inequality and redistribution is important for two reasons. First, it is often argued that societies do not redistribute as much as we should expect from democratic rule because the rich hold a disproportionate share of political power that enables them to prohibit the poor majority from expropriating them. Second, this relation is at the heart of the growing political economy literature on inequality and growth. This literature is divided into two trends. A first set of authors[1]

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[1]eg. Perroti(1993), Alesina and Rodrik(1994), Persson and Tabelini(1996,1997), Alesina and Perotti(1996)

argues that redistribution has large distortion costs, and more unequal societies grow more slowly precisely because their relatively poor majority can pressure the government to perform large inefficient transfers. Another set of authors[2] argues instead that the benefits of redistributing are large when the poor are credit constrained and production entails diminishing returns, but more unequal societies grow more slowly precisely because they redistribute less than more equal ones. They argue that wealth inequality induces political inequality, and the (more powerful) rich segment of the population is therefore able to impose inefficiently low redistribution rates. In this chapter, we want to concentrate on this link between inequality and redistribution, and test the validity of these popular political economy arguments. We will show how this relation rests on specific assumptions about the political system. In doing so, we will somewhat ignore the overall net effect of inequality on growth and output.

The simple political economy model we use fits in the framework defined by Verdier[1994]. Given an initial distribution of wealth, the political system aggregates interests and a particular economic policy option (like the amount of income redistribution) is chosen by society. This policy will in turn affect the future distribution of wealth and future tax rates. At the heart of this dynamics lies an imperfect credit market or some sort of non-convexity in production that perpetuates wealth disparities. Depending on their initial conditions and on their political mechanism, countries will grow at different rates, and end up on different income distribution equilibria.

Models of the economy that exhibit such characteristics are numerous and have been widely studied. We chose to work along the lines of Banerjee, Newman[1991], Galor, Zeira[1993] and Bénabou[1996,1999] because they are very tractable and well suited for the issues we want to analyze. In particular, the model builds on Bénabou[1996] and tries to explore in greater detail the relation between political bias and redistribution. It consists of a one-good economy of non-overlapping generations of credit constrained agents. These agents are born with some initial endowment of physical and human wealth. They face a technology that exhibits diminishing returns to private investments. Politics and voting come into play to explain why some societies might be more redistributive than others. The

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[2]e.g. Bénabou(1996,1999), Bourguignon and Verdier(1997), and, Saint-Paul and Verdier(1996)

idea is that the individual costs and benefits of redistribution vary among the population. Therefore, support for redistribution will depend on the distribution of political power in society. Following a variant of Bénabou[1999], we model the public choice as a voting mechanism where an individual's voice is some function of his or her wealth. We argue that this reduced form of the political game covers a wide range of political economy models where wealth matters for politics. One contribution of this chapter to the existing literature is to generalize the simple political mechanisms usually assumed in this kind of models, and to show how previous results depend strongly on the assumptions they make. We derive conditions on the political system under which inequality affects positively or negatively the wealth of the decisive voter, the amount of redistribution, and output.

More precisely, we identify two channels that relate inequality and redistribution. First, keeping the income level of the decisive voter constant, changes in the income distribution will affect his or her preferences in terms of redistribution. Assuming a log-normal distribution of income and a specific progressive redistributive scheme, we show that the amount of redistribution will *increase* in response to a rise in inequality when the decisive voter is relatively *wealthy*, while it will *decrease* if the decisive voter is relatively *poor*. The progressivity of taxes drive this effect. It has been largely ignored in this literature because of the usual assumption of linear taxation.

The other channel that affects the amount of redistribution is the political one. A rise in inequality will affect the balance of powers between the rich and the poor, leading to a richer or a poorer decisive voter. We will use various examples of wealth-biased political systems to show what affects the direction of this relationship. Intuitively, in a very unequal, perfectly democratic society, a rise in inequality increases the number of poor relative to the rich when the income distribution is skewed to the right, leading to a poorer decisive voter. On the other hand, if the rich can buy votes, rising inequality might increase their relative political power, and lead to a richer decisive voter. While this argument seems very attractive to explain why unequal societies adopt wealth-biased social policies, it relies on particular assumptions on the relation between wealth and politics.

To give a simple example, assume that wealth is uniformly distributed between $0 and

$100 in the population, but that only people with wealth above $80 can vote. The initial decisive voter will have wealth $90 in this society. It is easy to see that a mean preserving spread of income could, if it does not spread incomes only to the end-tails, reduce the wealth of the decisive voter. In fact, this will be more likely the more exclusive the political system (say if the threshold was at $90 instead of $80). More than a very special example, this might well be relevant in a developing country, or more generally, in any country in its early stages of development when the economic and the political structures are dual in essence[3]. In poor countries, political power is often in the hands of the urbanized (modern sector) elites. If, for some reason, like the adoption of a new agricultural technology, the richest of the disenfranchised peasants are suddenly able to save some of their agricultural surplus, move to the city and enter the modern sector to earn a higher wage, the overall level of inequality will rise, but these newly enfranchised agents (the city poor or the 'rising middle classes') will certainly move the balance of political powers in their favor. To give another example that weighs the dice even more in favor of wealth biased political systems, assume not only that the people with wealth lower than $80 are excluded from politics, but that political power increases with wealth for those above $80, but with diminishing returns. In this case, a rise of inequality, due for example to a uniform rise in the relative productivity of the modern sector compared to the traditional sector, will also lead to a poorer decisive voter, since the income rise of the 'city poor' increases their political weight more than it increases the rich's, a standard concavity effect. We show how these two channels interact with the extent of political exclusion to give an interesting non-linear relationship between inequality and redistribution.

To illustrate these results and contrast them with previous work, we present three classes of political mechanisms. The first one exhibits political exclusion, where only people above a wealth threshold can vote for their interests [4]. In the second one, political weight depends, in a log-linear way, on the *absolute* level of endowments of the agents. In the third mechanism, political weight depends on the *relative* level of endowments, and political exclusion is based on rank rather than absolute wealth.

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[3] As was the case in most European countries between the 18th and the 19thcenturies

[4] such formulation would fit many developing countries where the rural citizens are largely excluded from the political process. The wealth threshold in this case would be the urban wage of new migrants.

The analysis focuses on static distributional conflicts where the citizen-voters are assumed to be myopic, or, alternatively, they are assumed not to take into account the effect of their votes on their offsprings' welfare. The economy is then a sequence of one-period lives, each of which is characterized by a static distribution conflict. In chapter two, we relax the myopia assumption and allow voters to look one period ahead. This introduces an additional cost of redistribution for those who hold political power. In the spirit of the works of Robinson [1996,1997], Bourguignon and Verdier [1997], and Saint-Paul and Verdier [1996], we show how the assumption that wealth gives political power can possibly reduce the demand for redistribution when voters are forward looking. The idea is that the wealthier internalize the fact that too much redistribution will lower their political weight in the future. This two-period framework is used to shed some light on the incentives of the politically powerful to pursue distributional policies that can be growth enhancing, when these policies adversely affect their future political weight.

This chapter is organized as follows: in section 1.3, we present some historical evidence which illustrates how the effect of inequality on redistribution depends on the level of economic and political development. Section 1.4 describes the assumptions of the model. Section 1.5 solves the model and analyzes how inequality affects redistribution in the myopic case. Section 1.6 presents the particular dynamics in three simple political systems. Section 1.7 concludes and discusses possible extensions.

1.3 Historical evidence

Empirical studies on the relation between the level of inequality and the amount of wealth redistribution do not show established results yet. There is no consensus that wealth inequality increases or reduces the amount of redistribution. Using cross-country evidence, Perroti[1996] finds no relation between the initial level of the Gini coefficient and the subsequent amount of government transfers. Moreover, most of the literature reviewed

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in Bénabou[1996] shows no significant relationship between inequality and redistribution. Person and Tabellini[1996] argue instead that more unequal societies redistribute more, but the correlation does not show up in cross-country regressions precisely because politically motivated redistributions often take the form of high public sector employment, subsidies and tariffs. None of these redistributive schemes are captured by the amount of government transfers or by the average tax rate. Finally, using a panel of 20 OECD countries, Rodriguez[1997] finds that inequality actually has a significant negative effect on the share of social transfers as a percentage of GDP.

The country-by-country historical evidence does not show one single general trend either. However, contrasting the nineteenth century European and American experiences with the more recent trends in the developing world gives interesting insights on the nature of the relation between inequality and redistribution. While every country and historical episode seems to somewhat nuance this relationship, some general stylized facts seem to emerge:

1. In the early stages of economic and political development, when political participation is low, or when political competition depends strongly on individual wealth, rising inequality seems to induce <u>increased</u> redistribution.

The history of the development of welfare states in Western Europe and America shows how important was the historical political heritage in determining the timing and the extent of the rise in redistribution. There is now a consensus that most of these early industrializers experienced an initial rise in income disparities. As first proposed by Kuznets[1955], pressures in the demand for skills tend to widen the dispersion of incomes in the early stages of economic development, at the expense of those who are marginal to the process of industrialization[5]. The various country experiences surveyed in Flora and Heidenheimer[1981] show how the rise of the welfare states was clearly posterior to these increases in inequality, suggesting a positive relation between inequality and redistribution, as implied by a simple median voter

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[5]For evidence of this increasing part of the Kuznets curve in nineteenth century Europe, refer to Williamson[1991,1997] for England, Soderberg[1991] for Sweden, Scholliers[1991] for Belgium, Thomas[1991] for Australia, Kaelble[1991] for Germany, and Kraus[1998] for an extensive survey.

argument[6]. Their study concludes that the initial political system and the extent to which incomes spread, were crucial elements in shaping the extent of redistribution. In particular, they argue that the level of inequality *among the enfranchised* was a key determinant of the development of the welfare state.

Flora and Heidenheimer[1981] also show how the propensity to introduce social insurance schemes was much higher in constitutional-dualistic monarchies (Austria, Denmark, Germany and Sweden) than in parliamentary democracies (France and Switzerland), a feature of exclusionary politics that will emerge out of our simple static model. Moreover, they find that the extent of enfranchisement was positively correlated with the amount of redistribution.

In Germany, political mobilization of the working class was the main variable that drove the construction of the welfare state in the 1880's. Denmark was first to develop a generous social welfare system in 1880 and was the most urbanized country in Europe at the time, with the largest share of the labor force employed in the non-primary sector. It also had the highest rates of political participation. Lindert[1986] and Acemoglu-Robinson[1997] show how, in nineteenth century England, redistribution increased after the initial rise of inequality which preceded the partial extension of the franchise. Recent developing countries' experiences also support the view that in the early stages of economic and political development, inequality and redistribution are positively correlated. For example, Mabro and Radwan[1976] and Abdel-Fadil[1980] show how the rapid industrialization of Egypt between 1939 and the late fifties increased wealth disparities tremendously, leading to the rise of Nasserim and an era of increased public employment, land reforms and increased social expenditures. While we acknowledge that other theories could explain this general timing between rises in inequality and increased redistribution, the political economy link between income disparities and the demand for redistribution is a natural candidate to explain these historical facts.

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[6]There could of course be other plausible reasons that explain why redistribution episodes followed increases in income disparities. It could just be that the income-inequality relationship follows a Kuznets curve and redistribution increases with income.

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2. At later stages of development, when the political system remains wealth biased but incorporates more segments of the population, especially the middle classes, rising inequality seems to <u>decrease</u> the amount of redistribution[7].

In Argentina, Marshall[1998] shows how inequality rose sharply in the eighties while the government adopted very conservative fiscal policies in the nineties, including a more regressive tax structure, and large cuts in the welfare programs, all of which only reinforced the already high wealth disparities. Similarly, Chile experienced a tremendous increase in inequality between 1974 and the early eighties (refer to Riveros[1998]), followed by large declines in social expenditures between 1984 and 1990. Interestingly, there was no change in the redistributive policy following the return to democracy in 1990. Similar trends affected Mexico, Brazil, Equador, Peru and Bolivia in the eighties and nineties[8]. Similar trends were experienced by the United States, England, and part of Continental Europe, where wealth inequalities have risen sharply since the seventies, followed by an era of fiscal conservatism[9]. In their collection of studies on the political economy of Malaysia, Fisk and Osma-Rani[1982] explain how the rapid industrialization of the seventies induced an unprecedented rise in wealth inequalities which translated into a highly regressive tax system. Turkey is another example where redistributive issues are important in electoral politics, and where the social policies adopted have closely followed changes in the income distribution. Ozbudun and Ulusan[1985] show that between the early fifties and the end of the seventies, the level of wealth inequalities in Turkey followed an inverted-U shape, *à la* Kuznets. They argue that the pattern of redistribution rates followed approximately the inverse shape where the state grew increasingly conservative during the phase of increased inequality (thanks to the support of the urban poorest fringes to the conservative party). Later, when incomes became less dispersed, the state increased social spending, as the urban

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[7]In this chapter, we focus on political conflicts between groups and classes defined by their income. This is not to ignore that conflicts and political mobilization often form around other dimensions: economic sector, geographical location, ethnic background, special interests etc.

[8]Refer to Figueroa-Altamirano-Sulmont[1991] for Peru and Berry[1998] for a survey of the other Latin American countries

[9]See Rodriguez(1997) for evidence on this. He uses panel estimations on OECD countries

middle classes started to vote for the labor party. Finally, Chan[1997] shows that Singapore, Taiwan and South Korea were able to sustain an equalizing growth trend, followed by an era of increased democratization that led to higher redistribution rates. Again suggesting a negative correlation between inequality and redistribution.

3. Most of the twentieth century political experience could be described as class-based politics, where the rank in the income distribution and the ability of various income fringes to pressure the government seem to determine the political weight of agents. Nineteenth century politics, and developing countries' politics[10] seem, instead, to be dominated by the extent to which absolute wealth can influence decision making. This dichotomy is of course very imprecise, but our aim is to show how a changing role of wealth in politics can have large implications on the relation between inequality and redistribution, possibly explaining part of the variation we observe across time and regions in the amount of redistribution.

This chapter's aim is two fold. First, we want to show how a priori neutral assumptions on the type of political system can have large implications on the relation between inequality and redistribution, and see what precisely determines the direction of this relation. Second, we want to illustrate how these historical stylized facts can be explained using a very simple model of redistributive politics.

1.4 The model

Our model describes an economy of one-period lived agents who are credit constrained and who face a production function that exhibits decreasing returns to capital. It is a simpler version of Bénabou[1995]'s model with a more general political framework that enables

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[10]Refer to Bienen and Diejomadi[1987] for an excellent account of the political economy of Nigeria following the Oil discoveries, and Diamond, Linz and Lipset[1989,vol 2] for other African experiences

us to concentrate precisely on the political link between inequality and redistribution. As we go along, we will indeed contrast our results to his work and other previous work.

The economy is composed of a continuum of agents, denoted i, $i \in [0, 1]$. Everyone of these agents is endowed with an initial wealth b_i. This can be considered as bequested financial wealth, initial land holding or inherited human capital. A broader interpretation of b_i would also include the availability of public infrastructures for person i or his or her access to government services for the protection of property rights, his access to schooling infrastructures. These components of b_i (which are generally correlated with the other ones, physical and human capital) assume that public infrastructures and the government justice system are not available equally for everyone in the population and are not non-rival, as true public goods would be. This is mostly true in developing countries where public infrastructures (schools, roads, energy and water supply) are poorly developed in the rural areas or in the poor neighborhoods of the cities. Moreover, the rule of law is often discriminatory and the protection of property rights can be seen as a private good. Using this definition of initial endowment allows us to consider redistribution in a broader sense than pure taxation and transfers. It can mean enhancing property rights protection and fighting corruption[11].

We will assume that initial endowments are log-normally distributed in the population. Besides the fact that this simplifies a lot the mathematics of my model, true income distributions are indeed skewed to the right and closely follow a log-normal distribution, except at the very end of the upper tail[12]:

$$\ln b_i \sim N\left(m - \frac{\sigma^2}{2}, \sigma^2\right)$$

σ measures the level of inequality while e^m is the mean income. What is crucial in our analysis is not the log-normality, but the fact that the income distribution is skewed to the right and that increases in σ unambiguously translate in increased inequality[13]. We

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[11] These are forms of *redistribution* because fighting corruption means lower rents to the wealthier and more access to public services to the poor. Also, improving the protection of property rights for all, inevitably hurts the more advantaged because they can often more easily have the rule of law on their side.

[12] see, for instance, Atkinson [1983] and Lambert [1989]

[13] In other terms, in a Lorenz diagram, rises in σ unambiguously move the Lorentz curve of the distribution outward of the 45 degrees line, with not crossings occurring

exclude mean preserving spreads of the income distribution that affect only one tail, or which exhibits discrete transfers of income from the poor to the rich.

The sequence of events in the life of person i goes as follows:

1. Person i is born and inherits initial endowment b_i.

2. Society decides on a redistribution rate τ through a collective choice mechanism where individual i's political weight ω_i depends on i's endowment: $\omega_i = \omega(b_i)$[14]. Using a variant of the median-voter theorem where person i's voice counts as much as his political weight, that is, ω_i votes[15], the choice of society will reflect the preferred choice of the decisive ω_i-weighted median voter when preferences are single-peaked with respect to the policy variable τ. By using a reduced form political mechanism, we abstract from the possibility that wealth could be invested to increase political power, as a model of political contributions would imply.

3. Endowments are redistributed based on the voted rate τ[16].

Following Bénabou [1995,1996], we will model redistribution as a log-linear scheme where, given a chosen progressivity rate τ, and initial endowment b_i, post-redistribution endowment $\hat{b}_i$ is:

$$\hat{b}_i = cb_i^{1-\tau} \tag{1.1}$$

Where:

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[14]refer to Bénabou(1999) for a discussion on wealth and political influence

[15]a perfectly democratic society would have $\omega_i = 1 \ \forall i$. A one dollar-one vote society would have $\omega_i \equiv b_i$.

[16]Assuming that endowments are redistributed instead of incomes implies that there are no disincentive effects of taxation. This simplifying assumption allows us to focus on the pure distributional conflict in society, abstracting from the costs of redistributing. It is an assumption we need to make our model mathematically tractable. It will prove to be useful to have powerful implications, but of course ignores a major element in choosing the amount of redistribution, that is the extent of deadweight loss associated with it

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$$c = \frac{\int_0^1 b_i di}{\int_0^1 b_i^{1-\tau} di} = e^{\tau[m+(1-\tau)\frac{\sigma^2}{2}]}$$

The constant c in front of $b_i^{1-\tau}$ assures that the government budget constraint is satisfied (i.e. $\int_0^1 b_i di = \int_0^1 \hat{b}_i di$). The scheme is redistributive in the sense that $\hat{b}_i > b_i$ when $b_i < c^{1/\tau}$ and $\hat{b}_i \le b_i$ when $b_i \ge c^{1/\tau}$. Also, it is progressive since the individual proportional tax rate, $1 - cb_i^{-\tau}$, is increasing in b_i.

This scheme is particularly useful because it preserves the log-normality of endowments:

$$\ln \hat{b}_i \sim N\left(m - \frac{\hat{\sigma}^2}{2}, \hat{\sigma}^2\right) \tag{1.2}$$

with $\hat{\sigma}^2 = (1 - \tau)^2 \sigma^2$.

Moreover, if we measure the amount of redistribution by the decrease in the level of inequality that a given τ induces, then a higher τ unambiguously increases redistribution since post-tax income inequality level is reduced by $100\,\tau$ per cent. Unless otherwise specified, we will therefore use τ as our measure of redistribution, and will say, for example, that society A is more redistributive than society B when $\tau_A > \tau_B$, *irrespective of their relative inequality levels.*

The neutrality of this measure of redistribution with respect to inequality will enable us to draw unambiguous conclusions on the relation between inequality and redistribution. However, this measure is not fully consistent with other widely used measures like the size of the government as a percentage of GDP, or the *average* average tax rate. In fact, for this taxation scheme[17], the size of the government budget as a percentage of GDP is an *increasing* function of inequality, for a given τ; while the *average*

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[17]this holds also for quadratic schemes and, more generally, under certain non constraining conditions, for any progressive taxation scheme that depends monotonically on one parameter τ, as long as the government budget constraint binds. If the reader is interested, proofs can be obtained upon request.

average tax rate[18] is a *decreasing* function of inequality.

Our results depend on the assumption of progressivity of taxes[19]. We argue that the usual assumption of linear taxes is misleading for two reasons. First, income taxation is, to some extent, strongly progressive in the real world[20]. With decreasing returns of indirect utility with respect to income, fairness - in the sense of equal utility losses between agents, due to taxation - implies that the wealthier should pay a higher average tax rate. The second argument in favor of using progressive tax rates is the Jakobson-Kakwani theorem[21] that states that the post-tax income distribution is unambiguously more equal[22] than the pre-tax distribution if, and only if, taxes are progressive.

4. Person i then decides how much to consume (c_i^1) out of his initial net wealth $\hat{b}_i$, and how much to save (k_i) for future production and consumption.

We will assume that the credit market is non existent or imperfect[23], so that people cannot borrow: $c_i^1 + k_i = \hat{b}_i$. This may be a narrower assumption in the context of developing countries and it is central to arguments made here involving distributional issues. The poor, being credit constrained, can't borrow to make the optimal level of investment. Without credit constraints, everybody would choose that same optimal level of investment and total output and the growth rate would not depend on the initial distribution of incomes. With a decreasing returns to scale production function, more inequality will therefore lead to a lower output and there is room for efficient redistributions.

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[18]which is equal to $1 - e^{\tau \sigma^2}$ using our specific tax scheme.

[19]We believe that they are not driven by the particular functional form of taxation we chose, but only on the progressivity assumption. We found similar results using a quadratic taxation scheme. For some of our results - but not all - we were able to prove that they hold for any progressive scheme.

[20]This is mainly an empirical question for which we found very few evidence in the developing world. One could question the relevance of this progressive scheme to a developing country context. However, we could argue that taxes are strongly progressive in developing countries, since the majority of the population usually pay no taxes at all, while a majority do.

[21]refer to Lambert[1989] p.170

[22]meaning that the post-tax Lorenz curve is everywhere above the pre-tax Lorenz curve

[23]given the broader definition of initial endowment that includes human capital, access to public infrastructures and the rule of law, the non existent 'loan' market becomes a much weaker assumption than if it was a money market.

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5. Using their capital, people produce a quantity of output $2y_i$. We will consider the simplest production function, with an economy-wide externality *à la* Romer: $y_i = k_i^\theta k^{1-\theta}$, with $0 < \theta \le 1$ and $k = \int_0^1 k_i di$ is the average level of capital accumulated in the economy. Also, to simplify the analysis, we will assume that half of the production is consumed and the other half is bequeathed to an offspring.

In the one period model, the externality plays no role at all. The government budget constraint assures that the aggregate level of capital invested in the economy is unaffected by the redistribution. However, when the model is extended to two periods, forward looking voters will have an additional incentive to redistribute because, as we will show in chapter two, it will increase next period's aggregate stock of capital, and hence future productivity.

It is clear that the one-period optimal redistribution rate in this set-up is the one that corresponds to total redistribution, $\tau = 1$. It will indeed maximize total output since the individual production function is concave in k^{24}. The growth rate, defined as the growth of aggregate wealth in one generation is also maximized when $\tau = 1$. Note that by redistributing ex-ante, we left aside the disincentive effect that is usually associated with redistribution. We did so for two reasons. First, we want to concentrate on the pure distributional conflict among agents that leads to non-optimal policy adoption, taking as a benchmark total redistribution as the optimal choice for the society as a whole. If redistribution were costly, the costs of the distributional conflict would be lower. Second, and most importantly, we want to use the model to investigate policy choices that do not affect marginal choices on consumption, labor supply or investment, as taxation and money transfers would. Examples include a one and for all land reform; the equitable allocation across the population of the public education budget, rather than the size of the budget itself; giving away monopolies; and the extent to which the government enforces a just and equitable rule of law.

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[24]We could question the assumption of concavity of the production function with respect to physical capital at the individual level. It is more robust when thinking about human capital as the factor of production. Diminishing returns would then be a more appropriate assumption

6. Half of the production, y_i, is bequested to an offspring. We assume a 'warm-glow' bequest motive where person i gets utility from the fact that his or her offspring starts life with some initial *net* endowment. This rather non-conventional assumption will allow us to illustrate, in the second part, one of the themes of the paper: the fact that when voting on an initial redistribution scheme, the politically powerful internalize the effect that redistribution will have on the future balance of political powers. The fact that people anticipate that the bequest they leave to their offspring will in part be taxed away by the next generation's vote, is internalized in their utility using this love of *net* bequest motive.

7. The new generation of offsprings vote on τ^+, the progressivity rate of their redistribution scheme, which we will also assume to be log-linear. The offspring i starts out life with an after-redistribution endowment:

$$\hat{y}_i = c^+ y_i^{1-\tau^+}$$

Where $c^+ = \dfrac{\int_0^1 y_i \, di}{\int_0^1 y_i^{1-\tau^+} \, di}$

Individual i's preferences over initial consumption c_i^1, future consumption c_i^2 and the *net* bequest $\hat{y}_i$ is log-linear:

$$U_i = \beta_1 \ln c_i^1 + \beta_2 \ln c_i^2 + (1 - \beta_1 - \beta_2) \ln \hat{y}_i$$

1.5 Inequality and redistributive conflicts when voters are myopic

In this chapter, we will focus on the myopic version of the model ($\beta_2 = 1 - \beta_1$), where

agents don't look at the effect of their vote on their offsprings' welfare [25]. The utility of agent i therefore reduces to:

$$U_i = \beta_1 \ln c_i^1 + (1 - \beta_1) \ln c_i^2$$

1.5.1 Solving the model

Given a choice of the redistribution rate τ, maximization of this utility subject to the credit constraint leads all agents to invest the same fraction of their own post-tax endowment:

$$k_i = \frac{(1 - \beta_1)\theta}{\beta_1 + (1 - \beta_1)\theta} \hat{b}_i \qquad (1.3)$$

The redistribution rate preferred by agent i, τ_i, is the one that maximizes his or her lifetime utility. This is indeed the same tax rate that maximizes his post-redistribution endowment $\hat{b}_i$. Therefore, in the myopic case, the decision on τ is purely a *static redistributional conflict* over the initial pie of endowments. Because redistribution is done before the savings decision is taken, there are no distortive effects on investments.

Since the initial endowments, b_i, are log-normally distributed with mean $m - \frac{\sigma^2}{2}$ and variance σ^2, one can use (1.1) and compute the post-redistribution endowments $\hat{b}_i$ (for a given choice of τ):

$$\ln \hat{b}_i = (1 - \tau) \ln b_i + \tau m + \tau(1 - \tau)\frac{\sigma^2}{2}$$

Maximizing this expression with respect to τ, we find that agent i's preferred tax rate, τ_i is such that:

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[25] Chapter two explores the implications of having forward looking voters

$$1 - \tau_i = \frac{\ln b_i - [m - \frac{\sigma^2}{2}]}{\sigma^2} \qquad (1.4)$$

τ_i is of course decreasing in wealth b_i. Noting that $m - \frac{\sigma^2}{2}$ is the (log of the) median income, (1.4) shows that the people with wealth above the median favor a redistribution rate which is lower than 1 , while those below the median want it higher than 1 to invert the income distribution. Those with (log of) wealth above $m + \frac{\sigma^2}{2}$ even want to expropriate the poor (τ_i negative).

Rewriting(1.4) differently, we show that, rather than the *absolute* wealth b_i, what matters in person i's preferred redistribution rate in equation (1.4), is his or her *rank* in the income distribution, r_i, and the level of inequality σ:

$$1 - \tau_i = \frac{\Phi^{-1}(r_i)}{\sigma} \qquad (1.5)$$

Where $\Phi(.)$ is the c.d.f. of the standard normal distribution, so that agent i with wealth b_i has rank:

$$r_i = \Phi\left(\frac{\ln b_i - \left[m - \frac{\sigma^2}{2}\right]}{\sigma}\right)$$

Agents of higher rank want less redistribution. However, for an agent of higher (respectively lower) rank than the median, the desired amount of redistribution is *higher* (respectively *lower*), the higher the level of inequality. This is simply due to the fact that the agents above him in the income distribution (resp. below him), are moving up the tail of the distribution (resp. down the tail), and therefore, there is room for a higher (resp. lower) progressive redistribution rate while still keeping the government budget balanced[26]. A rise in inequality will consequently affect the preferred rate of the agent with wealth b_i both directly through $\frac{1}{\sigma}$, and indirectly by affecting his rank r_i in the income distribution.

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[26]This is mainly due to the progressivity of the taxation scheme. With linear taxation, preferences on redistribution are unaffected by the level of inequality

The net effect depends on where he or she stands initially in the income distribution. Differentiating (1.5) with respect to σ^2, we find that:

$$\frac{d\tau_i}{d\sigma^2} = \frac{\ln b_i - m}{\sigma^4} \qquad (1.6)$$

Interestingly, a rise in inequality increases the preferred tax rate of the agents with wealth above the mean income, and reduces the preferred rate of those below. The intuition behind this result goes as follows: for a given agent i with wealth b_i higher than some $\underline{b}$, a rise in inequality reduces his overall rank r_i in the income distribution. This is because some agents end up moving above him along the upper-tail of the distribution[27]. Conversely, if the agent i has wealth b_i lower than $\underline{b}$, the rise in inequality will increase his overall rank r_i since many agents will be getting poorer than him. These two groups of agents will respectively favor a higher and a smaller rate of redistribution because their rank levels are affected in opposite directions. Added to the *direct* positive effect of inequality on τ_i that affects all agents equally, the net effect on τ_i will be positive for those above a given threshold of wealth, and negative for those below. In our particular progressive redistribution scheme, that wealth threshold happens to be at the mean income level. This result is driven by the *progressivity* of the redistributive schedule and the skewness of the income distribution[28].

Which one of these agents' preferred tax rate will be adopted by society depends on the political system that aggregates interests. Given that the preferences over τ are monotonic in b_i and utility is single peaked with respect to the policy variable τ, the choice adopted by society will be the one preferred by the *weighted median* voter, where the weights are the number of votes wealth gives to every agent, $\omega(b_i)$. Under this political system, the pivotal voter in the society is the one whose wealth, b_p, corresponds to the median of the

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[27]It is important to understand that when we perform these exercises of distribution shifts, we look at the changes in preferences of the agents with a fixed wealth b_i, meaning that the identity of the agents who has this income changes as the income distribution moves

[28]Again, this result holds for other, more general, progressive tax schedules that depend on one parameter τ, as long as the government budget is balanced.

distribution of political powers:

$$\int_0^{b_p} \omega(b_i) dF(b_i) = \int_{b_p}^{\infty} \omega(b_i) dF(b_i) \tag{1.7}$$

Where $F(.)$ designs the cumulative distribution function of the b_i's[29]. For the clarity of notations, let's define the operator $\Im[.]$ such that, for any continuous function $u(x)$ of wealth x:

$$\Im[u(x)] \equiv \int_0^{b_p} u(b_i) dF(b_i) - \int_{b_p}^{\infty} u(b_i) dF(b_I) \tag{1.8}$$

$\Im[u(x)]$ measures the difference in the average of $u(x)$ between the people who are poorer than the pivotal voter and those who are richer. Using this notation, condition (1.7) can be written as:

$$\Im[\omega(x)] = 0 \tag{1.9}$$

Naturally, as $b_i \sim \ln N\left(m - \frac{\sigma^2}{2}, \sigma^2\right)$, b_p will be a function of σ^2, and the redistribution rate chosen by society will be the one of the agent with wealth b_p. Plugging into equation (1.4), we find that society's chosen tax rate will be:

$$\tau = 1 - \frac{\ln b_p(\sigma^2) - [m - \frac{\sigma^2}{2}]}{\sigma^2} = 1 - \frac{\Phi^{-1}\left(r_p(\sigma^2)\right)}{\sigma} \tag{1.10}$$

Where r_p is the rank of the pivotal voter in the income distribution.

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[29]for future reference, let $f(.)$ denote the corresponding probability distribution function

1.5.2 Inequality and the preferred choice for redistribution

Differentiating equation (1.10) with respect to σ^2 tells us that a rise of inequality will affect the chosen redistribution rate in two ways:

$$\frac{d\tau}{d\sigma^2} = \underbrace{\frac{\ln b_p(\sigma^2) - m}{\sigma^4}}_{\text{direct, economic effect}} - \underbrace{\frac{1}{\sigma^4}\epsilon_{b_p/\sigma^2}}_{\text{indirect, political effect}} \qquad (1.11)$$

Where $\epsilon_{b_p/\sigma^2} = \frac{\sigma^2}{b_p}\frac{db_p}{d\sigma^2}$ is the elasticity of the wealth of the pivotal voter with respect to σ^2.

The first effect reflects the change in preferences over τ that follows the rise in inequality. As showed earlier, a pivotal voter richer than the mean income agent wants more of it and one poorer than the mean wants less of it. The second effect reflects the fact that the pivotal voter's wealth will be different in a more unequal society, since the balance of political powers will be changed. How it will vary depends on the political system defined by $\omega(.)$. If the pivotal voter becomes poorer in response to the inequality rise ($\epsilon_{b_p/\sigma^2} < 0$), he or she will push for more redistribution. If the political system is wealth-biased, the pivotal voter might end up being richer. He will then push for less redistribution. This negative political effect of inequality on redistribution might more than counterbalance the positive economic effect [30], and the response of such a society to an increase in inequality might be *less* redistribution.

Note that in (1.11), how large is the first term depends on how wealth-biased is the political system (i.e. how large is $\ln b_p$ compared to m and relative to σ). The second term is a priori not related to the wealth bias but to the extent to which increased dispersion in incomes increases the political power of the rich. In fact, a simple diminishing returns argument (i.e. ϵ_{b_p/σ^2} would be smaller for higher b_p), would suggest that the effect of inequality on redistribution described by (1.11), is most likely to be *positive* the *more* wealth-biased

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[30] assuming that, initially, the decisive voter has more wealth than the mean

is the political system, contrary to the usual argument.

1.5.3 Inequality and the decisive voter

By differentiating, with respect to σ^2, the implicit equation (1.8) for b_p, we find that:

$$\frac{db_p}{d\sigma^2} = -\frac{\sigma^2}{2\omega(b_p)b_p f(b_p)} \frac{d\Im[\omega(x)]}{d\sigma^2} \tag{1.12}$$

Recall that $\Im[\omega(x)]$ measures the difference in the aggregate political weight of those with wealth below b_p with those with wealth above b_p. If this difference rises in response to the inequality rise, it means that the "poor" have become more powerful and the pivotal decisive voter will consequently be poorer. How much poorer will he be depends on how much political power is concentrated around b_p. If $\omega(b_p)f(b_p)$ is large, only a small drop in b_p will be necessary to balance out the political weights between the "rich" and the "poor".

Using the integration chain rule successively, and applying condition (1.9), we find that a change in inequality affects the balance of powers between 'poor' and 'rich', in such a way that:

$$\frac{d\Im[\omega(x)]}{d\sigma^2} = -\frac{\ln b_p - [m + \frac{\sigma^2}{2}]}{\sigma^2} - \epsilon(b_p) + \frac{\Im[x^2\omega''(x)]}{2\omega(b_p)b_p f(b_p)} \tag{1.13}$$

Where $\epsilon(x) \equiv \frac{\omega'(x)x}{\omega(x)}$ is the elasticity of the political weight $\omega(.)$ with respect to wealth, or the percentage increase in the number of votes that the person with wealth x gets, when her wealth increases by one per cent.

The first term corresponds to a wealth bias effect. As inequality rises, some people in the middle range of the income distribution move upward along its upper-tail, others move downward along its lower-tail. When the (log of) wealth of the pivotal voter is smaller

than $m + \frac{\sigma^2}{2}$, some people who had income higher than b_p end-up poorer than the pivotal voter, and the balance shifts in favor of the poor. If the political system is so wealth-biased that, initially, $\ln b_p$ is above $m + \frac{\sigma^2}{2}$, the rise in inequality will actually increase the number of people with wealth above b_p and the balance will shift in favor of the rich. The more wealth-biased the political system, the more power is shifted to the rich when inequality rises.

While the first effect measures how many votes are shifted from the "poor" ballots (those with wealth below b_p) to the rich (or vice versa), the second part of (1.13) captures the extent to which these votes shifts make the rich more powerful and the poor even less powerful. At the margin b_p, the higher the elasticity of political power with respect to wealth ($\epsilon(b_p)$), the more power is shifted to the rich when incomes are spread to the tails. The $\Im\left[x^2\omega''(x)\right]$ term captures the *concavity* effect illustrated using a simple example in the introduction. The more concave is the relation between wealth and political power, the less will the rich benefit politically from getting richer. Similarly, the more convex is this function for the poor, the less they will loose, in terms of political power, from getting poorer.

In a perfect democracy, this last term vanishes, $\epsilon(.)$ is 0, $\ln b_p = m - \frac{\sigma^2}{2}$ and (1.13) is unambiguously positive: an inequality rise leads to a poorer median voter and to more redistribution. In a non-democratic society where wealth matters in politics, the pivotal voter can get richer or poorer depending on the sign of (1.13). A priori, it can go either way and any conclusion on how inequality affects redistribution rests on ad-hoc assumptions on the shape of $x^2\omega''(x)$ and on the elasticity of $\omega(.)$ at b_p.

Rewriting (1.13) in terms of the rank of the decisive voter, r_p, we find that:

$$\frac{d\Im\left[\omega(x)\right]}{d\sigma^2} = -\frac{1}{\sigma}\left(\Phi^{-1}(r_p) - \sigma\right) + O(b_p) \qquad (1.14)$$

Where $O(b_p) = -\epsilon(b_p) + \frac{\Im\left[x^2\omega''(x)\right]}{2\omega(b_p)b_p f(b_p)}$

Ignoring temporarily the second part in (1.14) and focusing on the wealth bias effect

shows that, interestingly, for a given political system that leads to a pivotal voter with rank r_p higher than the median, highly unequal societies (those with $\sigma > \Phi^{-1}(r_p)$) will be the ones where increases of inequality move power to the poor, while more equal ones will exhibit a positive relationship between inequality and the political power of the rich. Assuming that the political system is based on rank rather than absolute wealth, r_p will be invariant to changes in σ, and the relation between inequality and the wealth of the decisive voter will have an inverted-U shape, contrary to what we would think of highly wealth biased political systems ($r_p > \frac{1}{2}$):
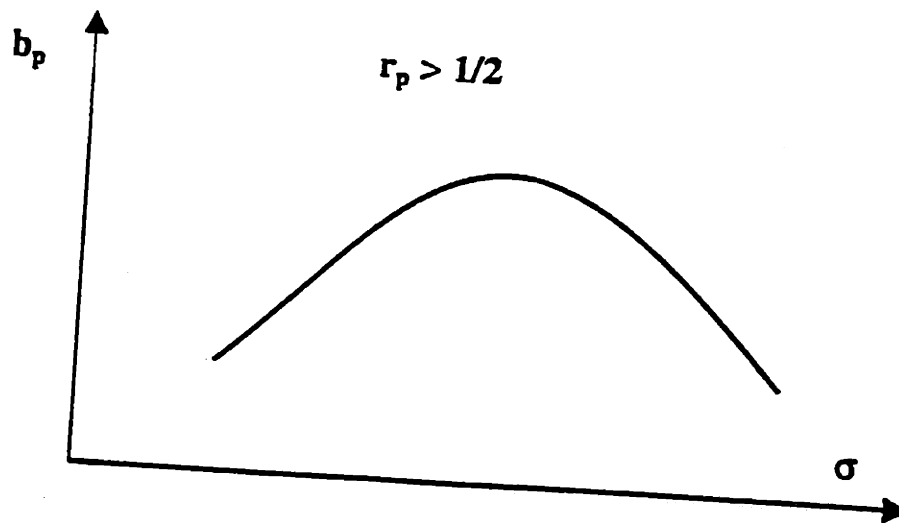
We will come back to this particular rank based political system in subsection 4.3, and show how the relation between economic inequality and political inequality can exhibit such non-linear characteristics.

1.5.4 Inequality and redistribution

The overall effect of inequality on redistribution, is the sum of the economic effect, the wealth-bias effect and the concavity effect. In my particular specification, the two first effects add up positively when the pivotal voter is wealthier than the median, and negatively otherwise. This need not be the case in general:

$$2\sigma^2 \frac{d\tau}{d\sigma^2} = \frac{\ln b_p - [m - \frac{\sigma^2}{2}]}{\sigma^2} - \epsilon(b_p) + \frac{\Im\left[x^2\omega''(x)\right]}{2\omega(b_p)b_p f(b_p)} \qquad (1.15)$$

1.5.5 Inequality and Growth:

In addition to the effect of inequality on redistribution, we want to find the net effect on growth. Growth in this model is proportional to total output given the externality in production. We will therefore focus in this section on the effect of inequality on average income, which translates into a growth effect.

The first, *direct* negative effect of inequality on output is due to the concavity of the production function when no credit market is available. When wealth is unequally distributed, a lot of poor invest a less than optimal amount of resources in production because they are credit constrained. Decreasing returns in production will therefore induce total output to be lower than if everybody could invest the same optimal amount. A perfectly equal society would, everything else kept equal, maximize total output.

The second channel through which inequality affects growth in this model is the political one. The distribution of wealth affects the distribution of political powers in society, which in turn affects the chosen redistribution rate and thus total output. As we have shown in (1.15), more inequality can lead to more or less redistribution depending on the wealth-based political system that aggregates the different interests.

These two effects can be seen at play in the expression of the (log of) total output y:

$$\ln y = \ln \frac{(1 - \beta_1)\theta}{\beta_1 + (1 - \beta_1)\theta} + m - \frac{\theta(1 - \theta)}{2}(1 - \tau)^2\sigma^2 \qquad (1.16)$$

An increase in inequality, keeping initial mean income m constant, will only affect the last term in (1.16). It will affect it directly through σ^2 and indirectly through politics via

$(1 - \tau)^2$. The direct negative effect can be compensated if $(1 - \tau)^2$ decreases accordingly (i.e. if redistribution raises in response to the increased inequality):

$$\frac{d\ln y}{d\sigma^2}_{|dm=0} = \underbrace{-\frac{\theta(1-\theta)}{2}(1-\tau)^2}_{\text{direct effect}} + \underbrace{\theta(1-\theta)\sigma^2(1-\tau)\frac{d\tau}{d\sigma^2}_{|dm=0}}_{\text{indirect, political effect}}$$

which can be rewritten as:

$$\frac{d\ln y}{d\sigma^2}_{|dm=0} = -\frac{\theta(1-\theta)}{2}(1-\tau)\left(1 - \tau - 2\sigma^2\frac{d\tau}{d\sigma^2}_{|dm=0}\right)$$

Moreover, we can also make use of (1.15) to rewrite $\frac{d\tau}{d\sigma^2}_{|dm=0}$ as:

$$2\sigma^2\frac{d\tau}{d\sigma^2}_{|dm=0} = 1 - \tau + \frac{\Im\left[x^2\omega''(x)\right]}{2\omega(b_p)b_p f(b_p)} - \epsilon(b_p) \tag{1.17}$$

So the change in the redistribution rate induced by an increasing inequality has two components: the first one (proportional to $1 - \tau$) measures the additional redistribution that the (previous) pivotal voter pushes for to compensate for the inequality rise (some sort of income effect). However, there is a second component that results from the change in the balance of political powers in society, induced by the inequality rise. This political change will then affect the redistribution rate as well. It comes from the fact that the wealth of the decisive voter in society will change due to the redistribution of political powers. The sign of this second term, $\frac{\Im[x^2\omega''(x)]}{2\omega(b_p)b_p f(b_p)} - \epsilon(b_p)$, depends of course on the shape of $\omega(.)$. Again, no general result can be given without strong assumptions on it. It depends on the elasticity of political power, $\epsilon(.)$ and on the concavity of $\omega(.)$. It measures how political power is redistributed between the rich (those with income higher than b_p) and the poor when inequality rises.

For instance, if $\omega(.)$ is convex for the poor and concave above some threshold, the redistribution will be in favor of the poor and it will push for higher redistribution. On the other hand, if politics are so wealth biased so that the elasticity $\epsilon(.)$ is increasing with wealth,

the integrals difference will be negative and the more unequal society will actually tend to redistribute less. The second term, which affects negatively the redistribution rate is likely to be positive. In fact, for realistic values of the parameters and of the specification of $\omega(.)$, this term might dominate the first one.

An interesting feature of the model is that the first effect (the counterbalancing effect to the rise of inequality, where society chooses to increase the redistribution rate, independently from the second political effect which could push for a poorer or richer decisive voter) exactly compensates for the direct negative economic effect of inequality. This comes from the log-linear structure of the model and is independent from the political mechanism at play or the other parameters. We are therefore left out only with the net political effect, and the rise of inequality only affects output and growth through this channel:

$$\frac{d\ln y}{d\sigma^2}\Big|_{dm=0} = \frac{\theta(1-\theta)(1-\tau)}{2}\left[\frac{\Im\left[x^2\omega''(x)\right]}{2\omega(b_p)b_pf(b_p)} - \epsilon(b_p)\right] \qquad (1.18)$$

In our log-linear model, inequality affects growth only through politics. When more wealth gives more political power, $\epsilon(.)$ is positive and the second term in the brackets of (1.18) is negative. Moreover, if a rise in inequality leads to a richer decisive voter, the first term will also be negative and the society will push for less redistribution: the economy will produce a smaller output.

1.6 Examples of political systems

To better understand how wealth and politics interact, we will analyze three particular forms of $\omega(.)$, starting with a simple political exclusion model. The later will be useful to explore how the *extent* of exclusion affects the dynamics of inequality and redistribution.

1.6.1 Political exclusion: $\omega(b_i) = 1$ if $b_i \geq \underline{b}$ and 0 otherwise

The simplest political mechanism we can think of would be one where only people with wealth above a certain threshold $\underline{b}$ could vote. We can think that there is a fixed cost to pay to enter politics or that only the urbanized citizen have the means to express their voice.

For clarity, we will assume that all the enfranchised agents have the same political weight. In this case, the pivotal voter is the median among the enfranchised and is richer than the median of the whole population, Computing his rank gives:

$$r_p = \frac{1}{2} + \frac{1}{2}\underline{r} \tag{1.19}$$

Where $\underline{r}$ is the rank of the poorest fringe of the population who can vote:

$$\underline{r} = \Phi\left(\frac{\ln \underline{b} - [m - \frac{\sigma^2}{2}]}{\sigma}\right) \equiv \Phi(\underline{B}) \tag{1.20}$$

Where $\Phi(.)$ is the cumulative distribution function of the standard normal distribution and $\underline{B} = \frac{\ln \underline{b} - [m - \frac{\sigma^2}{2}]}{\sigma}$.

Whether a rise in inequality leads to more or less redistribution depends on how the rank $\underline{r}$ is affected. More precisely, it will depend on whether the rise in inequality will exclude people from the franchise or whether it will include people in it. Interestingly, the more exclusive the political system (i.e., higher $\underline{b}$), the more likely will a rise in inequality enfranchise agents and push them above $\underline{b}$, leading to a lower exclusion rank $\underline{r}$, and a decisive voter of a *lower* rank:

$$\frac{dr_p}{d\sigma} = \frac{1}{2}\phi(\underline{B})\left(1 - \frac{\underline{B}}{\sigma}\right)$$

When $\ln \underline{b} > m + \frac{\sigma^2}{2}$, a rise in inequality *lowers* the rank of the decisive voter because, as

the income distribution is spread to the tails, many 'new rich' agents will be enfranchised. Conversely, when $\ln \underline{b} < m + \frac{\sigma^2}{2}$, the rise of inequality excludes 'middle class' agents from the franchise as they move down in poverty along the lower-tail of the income distribution. Therefore, given a threshold $\underline{b}$ larger than the mean income ($\ln \underline{b} > m$), the relation between inequality and the rank of the decisive voter is U-shaped:
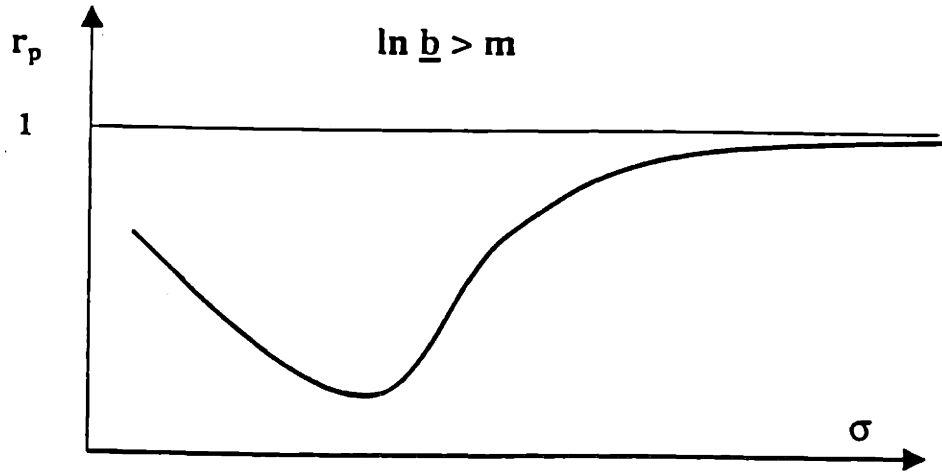
Recalling from (1.10) that the preferred distribution rate of the decisive voter is a *decreasing* function of his or her rank, and an *increasing* function of the level of inequality, the net effect of a rise of inequality on τ will depend on the relative weights of these two effects. It all depends on the initial inequality level and on the exclusiveness of the political system measured by $\underline{b}$. Differentiating equation (1.10) with respect to τ and using equations (1.19) and (1.20), we find that:

$$\frac{d\tau}{d\sigma} = 1 + \frac{1}{2}\frac{\underline{B}\phi(\underline{B})}{B_p\phi(B_p)}\left(1 - \frac{\sigma}{\underline{B}}\right)$$

Where $B_p = \frac{\ln b_p - [m - \frac{\sigma^2}{2}]}{\sigma}$.

When politics is very exclusive and, at least, all the agents with wealth below the mean cannot vote ($\ln \underline{b} > m$), the relation between redistribution and inequality will be S-shaped. At low initial inequality levels, only a small elite has political power and a rise of inequality will enfranchise part of the large disenfranchised middle class. The pivotal voter will consequently be poorer and he will unambiguously push for more redistribution as the two effects go in the same direction. At higher inequality levels, the middle class tightens and people are actually excluded from the franchise when incomes become more unequal. The decisive voter's rank increases and he will push for less redistribution. At these intermediate levels of inequality, the elasticity of the wealth of the decisive voter is high and positive so that the first effect dominates. At very high levels of inequality, the 'progressivity effect' starts to dominate the wealth effect, and rises of inequality only increases moderately the rank of the decisive voter while his preferences towards increased redistribution dominate. Basically, his rank is high and barely affected by inequality but the agents above him in the income distribution get richer so that his preferred rate of redistribution rises. For moderate political exclusion ($m - \frac{\sigma^2}{2} < \ln \underline{b} < m$), increases in inequality always increase the rank of the decisive voter, so the relation between τ and σ is U-shaped: at low inequality levels, the wealth-biased political effect dominates and more unequal societies redistribute less, while at high inequality levels, the reverse is true. If only a few agents are excluded from politics ($\underline{b} < m - \frac{\sigma^2}{2}$), the usual negative relationship between inequality and the wealth of the decisive voter applies, and more unequal societies will unambiguously redistribute more than more equal ones.

$\ln \underline{b} < m - \sigma^2/2$

$m - \sigma^2/2 < \ln \underline{b} < m$

$\ln \underline{b} > m$
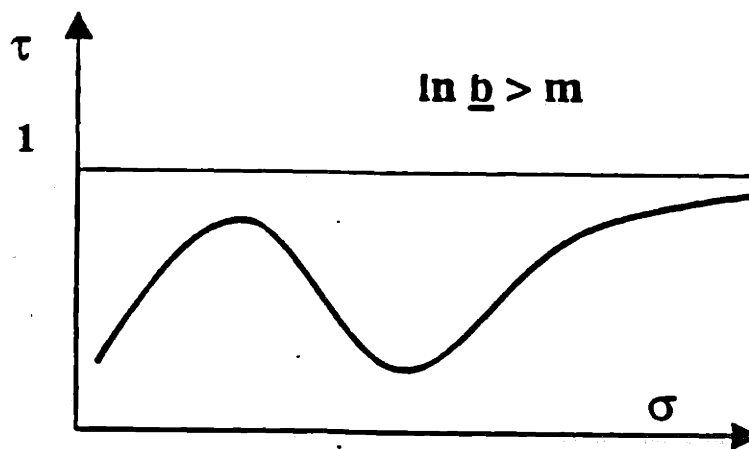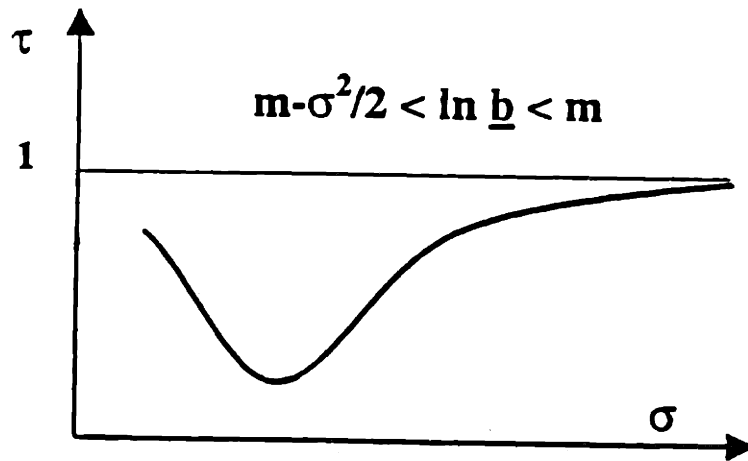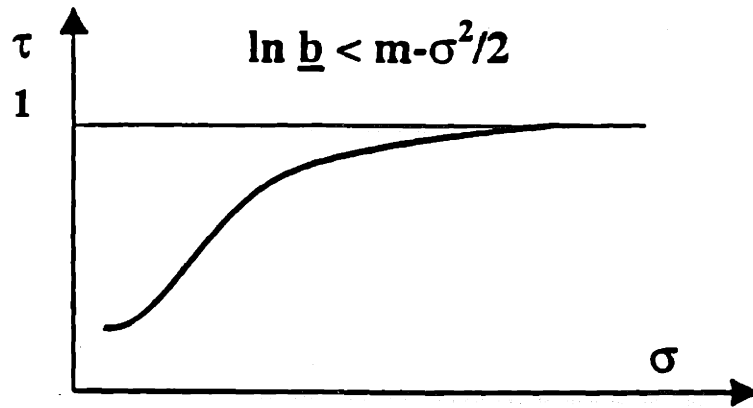
1.6.2 A wealth-based political system: $\omega(b_i) = b_i^\omega$

In this particular framework, the elasticity of political power with respect to wealth is constant, $\epsilon(b_i) = \omega$ and the concavity term in (1.13) vanishes: $\Im\left[x^2\omega''(x)\right] = 0$.

$\omega = 0$ corresponds to a purely democratic system, while $\omega = 1$ to a one dollar-one vote world. The pivotal voter is the one with (log of) wealth $\ln b_p = m + (2\omega - 1)\frac{\sigma^2}{2}$, and rank $r_p = \Phi(\omega\sigma)$. Whether he will get richer following a rise in inequality depends on how big is the elasticity of political power with respect to wealth, ω. When ω is smaller than $\frac{1}{2}$, he will actually end up being poorer. If ω is bigger than $\frac{1}{2}$, that is if the decisive voter has more wealth than the mean income m, a rise in inequality will make him richer. However, the progressive taxation effect is precisely positive for those with wealth above the mean. It turns out that for this particular specification, the two effects work in opposite directions and exactly cancel out for all values of ω. The chosen redistribution rate in such a society is independent of the initial distribution of wealth: $\tau = 1 - \omega$. In a purely democratic society, when everybody has the same weight in politics, there will be total redistribution: $\tau = 1$. Instead, in the extreme case of a one dollar-one vote society, there will be no redistribution at all.
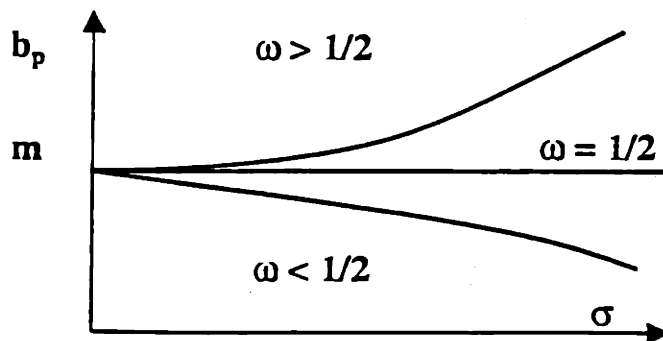
1.6.3 A rank-based political system: $\omega(b_i) = \delta\left[F(b_i)\right]$ for $F(b_i) \geq \underline{r}$

In this political system, used in Bénabou[1995,1996], the political weight of the person with wealth b_i, depends on her rank $F(b_i)$[31] in society rather on her absolute wealth: $\omega(b_i) = \delta\left[F(b_i)\right]$ when $F(b_i) \geq \underline{r}$, where $\underline{r}$ is the rank threshold below which agents have no voice in politics.

Therefore, the rank r_p of the pivotal voter is just the one that satisfies:

$$\int_{\underline{r}}^{r_p} \delta(x)dx = \int_{r_p}^{1} \delta(x)dx \tag{1.21}$$

Note that r_p does not depend on the initial level of inequality. Given a function $\delta(.)$, the rank r_p is implicitly derived from (1.21), and the wealth of the pivotal voter is $b_p = F^{-1}(r_p)$, which is an inverted-U function of inequality σ, as explained earlier.

The chosen rate of redistribution in such a society is given by:

$$1 - \tau = \frac{\Phi^{-1}(r_p)}{\sigma} \tag{1.22}$$

When the pivotal voter is of higher rank than the median voter (i.e. $r_p > \frac{1}{2}$), the chosen rate of redistribution is between 0 and 1. While it is higher than 1 when the pivotal voter is of lower rank than the median.

Since only rank determines political power, rises in inequality that do not affect the rankings in the income distribution will not affect the balance of political powers, and the rank of the pivotal voter will be unaffected. Therefore, the only effect of inequality on redistribution is through the progressive taxation effect:

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[31]recall that $F(.)$ is the c.d.f. of the wealth distribution.

$$\frac{d\tau}{d\sigma} = \frac{\Phi^{-1}(r_p)}{\sigma^2}$$

When the decisive voter is of higher rank than the median, a rise in inequality makes the agents of higher rank than him move up along the upper-tail, he will therefore push for more progressive redistribution. Conversely, if he is initially of lower rank than the median, a rise of inequality, keeping τ constant will lower his post-tax income because the agents of lower rank than him are getting poorer and are diverting fiscal transfers away from him. He will end-up preferring a lower redistribution rate. Again, as opposed to the usual intuition, the more wealth-biased are politics, the *higher* the increase in redistribution following a rise in inequality.

1.7 Concluding remarks and extensions

We started this chapter by asking why societies differed so much in the amounts and types of redistribution they adopt in the course of their economic development. One set of answers definitely lies in the relation between economic inequalities and political inequalities. We set up a political economy model of redistributive conflicts with very few ingredients, precisely to pin down the fundamental channels that affect the relation between inequality and redistribution. One channel, usually ignored in the literature, is the direct effect of inequality on the preferences over progressive taxation. We argue that this channel is unambiguously positive if the decisive voter in society is wealthy enough: everything else kept equal, societies naturally tend to counterbalance increased dispersion in incomes. The other channel is the political one. A rise in inequality affects the balance of political powers in society. In a perfect democracy, the pivotal voter unambiguously ends up being poorer. In a wealth biased society, whether he or she will get richer or poorer is ambiguous. We showed that, in general, it depends on the wealth bias of the system (i.e. how rich is the pivotal voter previous to the change in the income distribution), the elasticity of his polit-

ical weight with respect to wealth, and finally, the overall curvature of the function that relates wealth to political power. Therefore, any conclusion on how inequality affects powers in society rests on the specific assumptions made about the relation between wealth and politics. For example, a simple log-linear relation where political weight strictly increases with wealth will lead to a positive relationship between inequality and the wealth of the decisive voter, if and only if the elasticity of that relation is high enough. Wealth biasedness alone is not sufficient. Rather, we showed that it is the extent of political inequality *relative* to economic inequality that is key. More interestingly, in a system of class based politics, changes in the income distribution do not affect the rank of the decisive voter. When taxation is progressive, we are more likely to observe a positive correlation between inequality and redistribution, the *more* powerful are the higher classes in society, as opposed to the usual assumptions in the literature. Finally, by studying a simple political exclusion model, we was able to illustrate why the relation between inequality and redistribution might be positive in the early stages of economic and political development, while it might be negative at more advanced stages. The historical evidence seems to support these results.

Of course, we only analyzed the static distributional conflict that wealth and politics entail. A natural extension will be to allow for a second period in the model. This is the approach we develop in chapter two. In addition to the complex dynamics between inequality and redistribution of the one-period model, allowing period 1 agents to internalize the effect of their policy choices on the distribution of political powers of their offsprings will lead to an additional dynamic tradeoff for them:

On the one hand, people in the first period will want more redistribution than when they behaved myopically because redistribution will increase their offsprings' productivity in the second period through the production externality.

On the other hand, redistribution of income in period 1 will affect the balance of political powers in the second period. This is due to the fact that early redistribution will reduce inequality among the offsprings, which will affect the identity of their decisive voter and their redistributive policy. Political elites in period 1 might be inclined to reduce their offsprings' political weight by redistributing income, even if that can increase their produc-

tivity.

Another dimension along which the model would gain to be extended is the political one. In all our analysis, we treated the political system as fixed in both the short term and the long term. This is clearly a misleading assumption if we want to think about long term distributional conflicts. Societies evolve, constitutions and the social contract get revised. Often, the fear of major redistributions affect the dynamics of political change, in the spirit of Acemoglu and Robinson(1997,1999). In chapter two, we simplify our model but introduce political change and the threat of revolution in the two period framework to explore these dynamics.

Chapter 2

Redistribution, Political change and Wealth-based Politics

2.1 Abstract

We extend the model presented in chapter one to a two-period framework. The idea is to model how the prospect of *future* distributional conflicts affect present choices of redistribution and political reform when wealth gives political power. The aim of the model is to shed some light on the incentives of the politically powerful to pursue distributional policies that can be growth enhancing, when these policies adversely affect their future political weight. We illustrate this dynamic distributional conflict using two simple models of political power, where political weight depend on wealth or on rank in the income distribution. We show that the *more* wealth-biased the political system, the *lower* will be the redistribution rate in period 1, as the future political cost of redistributing is higher. We also provide some insights on how these dynamics behave when considering a more general form of political system. Finally, we introduce political change into the framework and present a model of franchise extension and redistribution that entails a risk of revolution. We find that when political weight is based on wealth, then an elite which chooses not to extend the franchise early, will choose a *higher* rate of redistribution, the *higher* the probability of a revolution occurring in period 2. The idea being that in a wealth-based political system, the expected future political cost of redistributing income in the first period is *lower*, the higher the probability that a revolution abolishes this wealth-based system.

2.2 Introduction

Many developing countries' experiences, especially in Africa, suggest that the leaders, at independence, might have had little incentives to pursue developmental policies. One argument to explain that is that these elites who could have themselves greatly benefited from growth realized that their political weight in society would have been challenged by a growing middle class. For example, in developing countries, the urban-rural economic gap generally translates into a political gap where only people in the urban modern sector can influence governments[1]. The incentives of this urban 'modernized' elite to promote growth enhancing policies are weakened by the prospect of having to face new interests in the future: growth implies urbanization and the rising of a politically powerful middle class of industrial workers or small entrepreneurs who will pressure for reforms and more redistribution. One striking illustration of this are the economic policies of colonial powers which explicitly denied any right to development to the autochtone populations in fear of pressure for more political freedom, independence etc.

Our model contributes to the political economy literature of inequality, redistribution and political change. It is in the spirit of Acemoglu-Robinson[2000] who develop a political-economy model where a powerful group blocks the adoption of a new technology because it threatens its political weight in the future. They call this the 'political losers hypothesis' that aims at explaining why the political elites might be willing to pursue sub-optimal policies from an economic standpoint to preserve their political power. Similarly, the model and case studies presented in Robinson[1997,1999] also argue for a political economy explanation of underdevelopment, where dictators are voluntarily inclined to choose non-developmental policies to preserve themselves from the growing new interests that economic development engenders. However, our model has different implications than Acemoglu-Robinson[2000]. While they argue that elites might intentionally choose *bad* policies for the economy like not building roads, or voluntarily choosing a low productivity technology; we only focus

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[1]the industrial class, the large landowners, the urbanized workers, the new middle classes, the state employees etc., all can more easily - democratically or undemocratically - pressure the government, than villages that can hardly coordinate and that are much poorer. Moreover, riots and revolutions in contemporary history were mostly triggered by new rising interest groups and middle classes in urban centers. See Huntington[1968], Diamond, Linz, Lipset Eds.[1995] and Tilly[1975]

on redistributive choices. We argue that except for extreme examples like Zaire or Haiti, where it is plausible that elites might have been inclined to adopt clearly anti-development policies; choosing low levels of redistribution or, bad types of redistributive mechanisms[2] to protect the political weight of the elites, might be more relevant to explain patterns in redistributive choices across countries, including middle or high income countries.

Possible examples of such strategic politico-economic choices by the elites include the former Zaire under Belgian colonial rule, and then under the rule of General Mobutu after independence; as well as the Duvallier rule of Haiti. Another interesting example is to look at the different policies adopted by very similar countries at independence: Algeria and Morocco. Both were under French colonial rule, were essentially rural societies at independence, and had similar levels of inequality and human development indicators. The difference was in their history of decolonization, where the first one experienced a violent uprising with the instauration of a revolutionary government at independence. Political power was very diffused among various interest groups and, even if institutions were not democratic, the political system was more inclusive of the voices of various parties. In contrast, Morocco restored its monarchy, the traditional structure of society was preserved and the political power highly concentrated among an elite at independence. These political differences translated into strong differences in redistributive policies. While Algeria invested massive resources into primary education, poverty alleviation, and rural infrastructure, Morocco had less redistributive policies. Inequality remained relatively high, illiteracy rates did not drop as much as in Algeria, schooling was not available to all in rural areas, and the relative size of the middle class was smaller than in Algeria. Not surprisingly, Morocco is a much more stable country than its neighbor. Political contestation has been more limited, and the political system and the monarchy are very immune from any pressure for change. Our theory would suggest that the Moroccan political elites might have made their redistributive choices at independence anticipating the costs that reditribution might bring to the stability of the Kingdom in the future.

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[2]Although we only model choices about the *amount* of redistribution, our argument would also hold if we considered choices among different *types* of redistributive mechanisms that have different implications on the distribution of political powers. Example: redistributing through universal education versus targeted subsidies to some sectors, or premia on public wages

Other models with similar arguments include Bourguignon-Verdier[1997] who develop a model where a small elite has to decide of a tax rate to finance public education expenditures. The elite face a tradeoff between the economic benefits education externalities entail and the future political cost of educating the masses. In their model, only educated agents can vote and voice their interest in the political arena. In another context, Saint-Paul and Verdier[1996] show how in a dual labor market, insiders (the employed) prevent the adoption of even limited labor market reforms that will not directly affect their present employment status, but that will reduce their future political weight as insiders, and eventually lead to the full reforms that they want to prevent[3].

We want to develop a model of inequality, redistribution and politics that captures these incentives to pursue pro-developmental policies. We use the same model analyzed in chapter one but extend it to a two-period model of politics. The models presented hereafter illustrate the complexity of dynamic political games. As soon as one allows voters to integrate the effect of their votes on the future distribution of political power, complex dynamics come into play. While deriving some general results for any arbitrary wealth-based political system, we will focus on the simple political mechanisms introduced in chapter one. We find that in a wealth-based political system, redistribution will be higher when voters are myopic since they do not integrate the future political cost that period 1 redistribution will cause to their offsprings. Also, the more wealth biased is the political system, the higher this cost, and the lower the redistribution rate voted by non-myopic voters in period 1. These tradeoffs of course depend on the discount rate and the extent to which redistribution increases average productivity through a production externality. We also introduce the prospect of political change into the model, by allowing for strategic franchise extensions in period 2. We find that when political weight is based on wealth, then an elite which chooses not to extend the franchise early, will choose a *higher* rate of redistribution, the *higher* the probability of a revolution occurring in period 2. The idea being that in a wealth-based political system, the expected future political cost of redistributing income in the first period is *lower*, the higher the probability that a revolution abolishes this wealth-based system. Also, the higher the initial level of inequality and the wealth-biasedness of the political system, the more

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[3]The insiders are, in this case, 'political loosers' but not 'economic loosers', to use the terminology of Acemoglu-Robinson[2000].

likely will the elites extend the franchise early to preserve the political structure and avoid a revolution. This strategic franchise extension is motivated by the prospect of preserving the wealth-biasedness of the political system, even at the cost of extending political voice to all.

This chapter is organized as follows: in the next section, we present the two-period version of the static political economy model we studied in chapter one. In subsection 2.3.1 and 2.3.2, we solve the model for the two simple specifications of the relation between wealth and political power we already introduced in chapter one. In section 2.4, we partly solve the general model where no particular functional form is assumed. Section 2.5 introduces political change and the threat of revolution in the basic model. Section 2.6 concludes.

2.3 A two-period political economy model of redistribution

To try to get a sense of how the incentives to adopt developmental policies[4] interact with the political system, the economy and the initial distribution of wealth, we extend the model developed in chapter one to allow for another period and forward looking agents.

The set-up is the same except that a second generation is born with a bequest inherited from the first generation. Part of this bequest is taxed away following a voting process. The first generation anticipates this when they make their policy choices because they care about the *net* wealth their offsprings start life with.

To simplify the analysis and to make it mathematically tractable, we will ignore the savings decision in the first period. We saw that the one period problem was reduced to a static distributional conflict over the initial pie of endowments. Incentives played no role in that framework because the savings decision was taken after redistribution. When we add one period, the disincentive effect of taxation of offsprings come into play. The problem

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[4]through welfare improving redistributions like land reform, public education, infrastructures in rural areas etc.

becomes non-tractable and its first order conditions give no information on the solution. Therefore, we will ignore this effect and concentrate on the dynamic distributional conflict that is of most interest to us. The model goes as follows:

The economy is composed of a continuum of agents, denoted i, $i \in [0,1]$. Everyone of these agents is endowed with an initial wealth b_i. This can be considered as bequested financial wealth, initial land holding or inherited human capital.

The sequence of events in the life of person i goes as follows:

1. Person i is born and inherits the initial endowment of b_i.

   We will again assume that initial endowments are log-normally distributed in the population. Besides the fact that this simplifies a lot the mathematics of my model, true income distributions are indeed skewed to the right and closely follow a log-normal distribution, except at the very end of the upper tail[5]:

   $$\ln b_i \sim N\left(m - \frac{\sigma^2}{2}, \sigma^2\right)$$

   σ measures the level of inequality and e^m the mean. What is crucial in our analysis is not the log-normality, but the fact that the income distribution is skewed to the right and that increases in σ unambiguously move the Lorentz curve outward of the 45 degrees line. We exclude mean preserving spreads of the income distribution that affect only one tail, or which exhibits discrete transfers of income from the poor to the rich.

2. Society decides on policy through a collective choice mechanism where individual i's political weight ω_i depends on i's endowment: $\omega_i = \omega(b_i)^6$. Using a variant of the median-voter theorem where person i's voice counts as much as his political weight,

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[5]see, for instance, Atkinson [1983] and Lambert [1989]

[6]refer to Bénabou(1999) for a discussion on wealth and political influence

that is, ω_i votes[7], the choice of society will reflect the preferred choice of the decisive ω_i-weighted median voter when preferences are single-peaked with respect to the policy variable τ. By using a reduced form political mechanism, we abstract from the possibility that wealth could be invested to increase political power, as a model of political contributions would imply.

3. Society decides on the redistribution rate, τ. We use the same progressive redistribution scheme of Bénabou[1996]. This scheme preserves the log-normality of the distribution of wealth and leads to closed-form solutions for most of our derivations. After redistribution takes place, person i who initially has wealth b_i ends up with wealth $\hat{b}_i$:

$$\hat{b}_i = b_i^{1-\tau} \frac{\int_0^1 b_i di}{\int_0^1 b_i^{1-\tau} di}$$

4. Person i produces $2y_i = 2\hat{b}_i^{\theta} b^{1-\theta}$, consumes half of it and leaves the other half to her offspring.

5. An offspring i is born and inherits an initial endowment of y_i.

6. The offsprings decide on their redistribution rate, τ^+. Offspring i ends up with wealth:

$$\hat{y}_i = y_i^{1-\tau^+} \frac{\int_0^1 y_i di}{\int_0^1 y_i^{1-\tau^+} di}$$

7. Offspring i produces $2z_i = 2\hat{y}_i^{\theta} y^{1-\theta}$, where $y = \int_0^1 y_i di$; consumes half of it and leaves the other half to her own offspring.

The utility of person i is an increasing and concave function of her own consumption and her offspring's consumption:

$$U_i = \beta_1 \ln y_i + (1 - \beta_1) \ln z_i$$

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[7] a perfectly democratic society would have $\omega_i = 1 \ \forall i$. A one dollar-one vote society would have $\omega_i \equiv b_i$.

When the offsprings are born, they behave myopically. Not surprisingly, they will choose a redistribution rate τ^+ which has the same properties of the rate we studied in the myopic model in chapter one. Using the same notation with $'+'$ as a subscript to denote the future generation (period 2), the preferred tax rate τ_i^+ of a myopic offspring i with wealth y_i will be the one that maximizes his or her post-tax income[8]:

$$\tau_i^+ = \overset{\{\tau^+\}}{Argmax} \; (1-\tau^+)\ln y_i + \ln \int_0^\infty y_i dF^+(y_i) - \ln \int_0^\infty y_i^{1-\tau^+} dF^+(y_i) \qquad (2.1)$$

Where $F^+(.)$ is the cumulative distribution function of the incomes of the offsprings, y_i.

Denoting m^+ the (log of) the mean income of the offsprings and σ^+ their standard deviation, the log-linearity of the model insures that the offsprings' wealth y_i is log-normally distributed:

$$\ln y_i \sim N\left(m^+ - \frac{\sigma^{+2}}{2}, \sigma^{+2}\right)$$

So that:

$$\ln \int_0^\infty y_i dF^+(y_i) = m^+$$

and,

$$\ln \int_0^\infty y_i^{1-\tau^+} dF^+(y_i) = (1-\tau^+)m^+ - \tau^+(1-\tau^+)\frac{\sigma^{+2}}{2}$$

Plugging this into (2.1), we find that the tax rate τ_i^+ that maximizes post-tax income of offspring i is such that[9]:

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[8] Recall that the redistribution takes place before investment and production decisions are made, so that taxes have no incentive costs and agents just want to maximize their post-tax income

[9] This corresponds to equation (1.4) in the myopic model of chapter one

$$1 - \tau_i^+ = \frac{\ln y_i - \left(m^+ - \frac{\sigma^{+2}}{2}\right)}{\sigma^{+2}} \tag{2.2}$$

While second period preferences are similar to the one-period model in the sense that the preferred tax rate is just the one that maximizes post-tax income, the choice of τ in the first period will entail two additional conflicting dynamics that did not exist in the one period myopic model:

First, people in the first period want more redistribution than when they behaved myopically because redistribution will increase their offsprings' productivity in the second period through the production externality $y^{1-\theta}$. Since there are diminishing returns to the only factor of production, Jensen's inequality implies that there will be a higher average output y, the higher the redistribution in first period (i.e. the more equally distributed are the $\hat{b}_i$'s.).

The second effect is that redistribution of income in period 1 will affect the balance of political powers in the second period. Recalling from chapter one that a rise in inequality affects the wealth of the decisive voter, more redistribution in period 1 will reduce the inequality of wealth among the offsprings and affect accordingly the wealth and preferences of the offsprings' decisive voter, and therefore the second period tax rate and welfare.

In chapter one, we showed how the type of relation between wealth and politics determined the effect of changes in the distribution of wealth on the identity of the decisive voter in society. More specifically, we found that if an offspring with wealth y_i in period 2 has weight $\omega(b_i)$ in politics, then, a rise in σ^{+2} - the inequality of the distribution of the y_i's, in particular because of a lower redistribution rate τ in period 1 - , will lead to a corresponding change in the wealth of the decisive voter, b_p^+, in period 2, such that[10]:

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[10] $\sim$ refers to *proportional to*. For clarity we omitted a constant positive factor in front of the right hand side

$$\frac{db_p^+}{d\sigma^{+2}} \sim \frac{\ln b_p^+ - [m^+ + \frac{\sigma^{+2}}{2}]}{\sigma^{+2}} - \epsilon(b_p^+) + \frac{\Im^+\left[x^2\omega''(x)\right]}{2\omega(b_p^+)b_p^+ f^+(b_p^+)} \qquad (2.3)$$

Where $\epsilon(.)$ is the elasticity of political power with respect to wealth; $f^+(.)$ is the distribution function of wealth in period 2; and $\Im^+[X_i]$ is the difference between the average of variable X_i for offsprings i poorer than b_p^+ and the average of X_i for agents richer than b_p^+, using a similar notation as in chapter one:

$$\Im^+\left[x^2\omega''(x)\right] \equiv \int_0^{b_p^+} x^2\omega''(x)dF^+(y_i) - \int_{b_p^+}^{\infty} x^2\omega''(x)dF^+(y_i)$$

Since more redistribution in the first period reduces the inequality of wealth y_i of the offsprings, period-one voters will be inclined to vote for less redistribution if the sign of $\frac{db_p^+}{d\sigma^{+2}}$ in (2.3) is positive: more redistribution in period 1 would mean a *smaller* σ^+ in period 2, a *poorer* decisive voter, and most likely, even *higher* tax rates in period 2. Therefore, depending on the shape of $\omega(.)$, political elites in period 1 have an interest in keeping redistribution low and inequality high - at the cost of a smaller production externality for their offsprings - to ensure that their political power is preserved and transferred to their 'children'[11].

We believe that the conflict between these two effects plays an important role to explain the policy choices made by a lot of developing countries at independence. In fact, we will concentrate more in this chapter on these two effects and less on the inequality dynamics studied in the myopic model of the first chapter, keeping in mind that this dynamic between inequality and the distribution of political power is still determinant of the chosen redistribution policy, in both periods.

Before turning to the general political model, we will look at the simple cases of a wealth-based and rank-based political systems already introduced in chapter one.

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[11]Note that if we introduced some stochastic shocks to income in the model, there would be an additional *insurance* motive to redistribute in period 1, as agents would like to reduce the volatility of income of their offsprings

2.3.1 Two periods in a wealth-based society, $\omega(\mathbf{b_i}) = \mathbf{b_i^\omega}$

When wealth log-linearly determines political weight, the decisive voter in period 2 will have wealth b_p^+ such that:

$$\int_0^{b_p^+} y_i^\omega dF^+(y_i) = \int_{b_p^+}^\infty y_i^\omega dF^+(y_i)$$

Where $F^+(.)$ is the cumulative distribution function of the y_i's. Solving for b_p^+ using appropriate changes in variables, we find that:

$$\ln b_p^+ = m^+ + (2\omega - 1)\frac{\sigma^{+2}}{2} \tag{2.4}$$

Similarly, in period 1, the wealth b_p of the decisive voter is such that:

$$\ln b_p = m + (2\omega - 1)\frac{\sigma^2}{2} \tag{2.5}$$

In period 2, society will choose a redistribution rate τ^+ given by plugging (2.4) into (2.2), which gives us:

$$\tau^+ = 1 - \omega$$

In period 1, a voter i with wealth b_i and facing a first-period redistribution rate τ will have a lifetime utility:

$$U_i = \beta_1 \ln \hat{b}_i^\theta b^{1-\theta} + (1 - \beta_1) \ln \hat{y}_i^\theta y^{1-\theta} \tag{2.6}$$

Where $y_i = \hat{b}_i^\theta b^{1-\theta}$ is her production in period 1. $\hat{y}_i$ is the post-tax wealth in period 2 when the tax rate τ^+ is $1 - \omega$:

$$\hat{y}_i = y_i^\omega \frac{\int_0^1 y_i di}{\int_0^1 y_i^\omega di}$$

$\hat{y}_i^\theta y^{1-\theta} = z_i$ is the production in period 2, where y is the average wealth of the offsprings.

Maximizing U_i with respect to τ_i gives the preferred period 1 tax rate of agent i whose wealth is b_i. Replacing b_i, by b_p - the wealth of the decisive voter in period 1 - gives us society's choice of redistribution in that first period:

$$1 - \tau = \frac{\beta_1 + \theta(1 - \beta_1)\omega}{\beta_1 + (1 - \beta_1)(1 + \theta^2\omega^2 - \theta)} \omega \qquad (2.7)$$

Note that when $\beta_1 = 1$ and agents only care about the one period utility, the preferred tax rate is equal to the one we found in the myopic version of the model: $1 - \omega$. The difference in the two periods case is due to the two additional opposing effects of redistribution that appear in the fraction in from of ω in (2.7): the negative effect due to the future political costs and the positive externality effect. To understand how these two interact, it is useful to see how the chosen τ varies with the different parameters. First notice that, in this political system, redistribution will always be smaller in the non-myopic case compared to the myopic case studied in chapter one[12].

Note also that when $\theta = 1$, production is linear and there is no externality effect. Voters in period 1 are left out with the negative future political cost of redistribution. They will therefore vote for *less* redistribution than if they ignored the future. On the contrary, when $\theta = 0$, everybody produces the same output in both periods. There is no distributional issue in the second period, and there is an incentive to redistribute *more* in period 1, so as

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[12]i.e. the fraction in front of ω in (2.7) is always higher than 1

to benefit from a higher productivity in the future.

Proposition 1 *The more money matters for politics (the* **higher** *ω), the* **higher** *the future political costs of early redistribution compared to its benefits on productivity, and the* **lower** *the redistribution rate in period 1:*

$$\frac{d\tau}{d\omega} < 0$$

Proof: Let $D(\beta_1) = \frac{d(1-\tau)}{d\omega}$ be the derivative with respect to ω of (2.7). Let $N(\beta_1) = [\beta_1 + (1-\beta_1)(1+\theta^2\omega^2 - \theta)]^2 D(\beta_1)$. $N(1) = 1$ and $N(0)$ is positive and proportional to $\theta\omega(1-\theta)$. Moreover, $N(\beta_1)$ is a continuous function, and its first derivative, $N'(\beta_1) = \frac{dN(d\beta_1)}{\beta_1}$ is linear in β_1, so that it crosses the horizontal axis at most once between 0 and 1. Therefore, $N(.)$ has at most one maximum or one minimum. It turns out that $N(.)$ is concave as long as $\omega < 2$,[13] so that it can only be a maximum. Since both $N(0)$ and $N(1)$ are non-negative, $N(\beta_1)$ must be non-negative for all values of β_1 between 0 and 1. Therefore $\frac{d\tau}{d\omega} < 0$. **QED.**

Proposition 2 *The less important the externality in production (the* **higher** *θ), the* **smaller** *are the future benefits of early redistribution compared to its political costs, and the* **lower** *the redistribution rate in period 1:*

$$\frac{d\tau}{d\theta} < 0$$

Proof: Let $D(\beta_1) = \frac{d(1-\tau)}{d\theta}$ be the derivative with respect to θ of (2.7). Let $N(\beta_1) = [\beta_1 + (1-\beta_1)(1+\theta^2\omega^2 - \theta)]^2 D(\beta_1)$. $N(1) = 0$ and $N(0) = \omega(1-\theta\omega)(1+\theta\omega) > 0$. Moreover, $N(\beta_1)$ is a continuous function, and its first derivative, $N'(\beta_1) = \frac{dN(\beta_1)}{d\beta_1}$ is linear in β_1, so that it crosses the horizontal axis at most once between 0 and 1. Therefore, $N(.)$ has at most one maximum or one minimum. This has to be a maximum because $N(0) > N(1) = 0$ and $N'(1) = -\omega + 2\theta\omega^2 - 1$ is negative when $\omega \leq 1$. Therefore, $N(\beta_1)$

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[13]Recall from chapter one that we constrain ω to be smaller or equal to 1. When ω is larger than one, the one-period tax rate is higher than 100% and is not incentive-compatible

does not cross the horizontal axis between 0 and 1 and it is always positive. Consequently, $\frac{d\tau}{d\theta} < 0$.   QED.

Finally, the tradeoffs between these incentives to redistribute and their future political costs depend on how the utility of the offspring is weighted. Intuitively, it depends on how important are the benefits of redistributing, as measured by the externality and concavity measure θ. Denoting $\delta \equiv \frac{1-\beta_1}{\beta_1}$ the discount rate, we find the following result:

Proposition 3 *When θ is* **small**, *the future positive externality effect dominates the future negative political cost of redistribution. Therefore, the redistribution rate is* **higher**, *the* **bigger** *is δ, the weight on the future: when $\theta \leq \theta_1$ (with $\theta_1 = \frac{1+\omega-\sqrt{(1-\omega)(3\omega+1)}}{2\omega^2}$ is between 0 and 1):*

$$\frac{d\tau}{d\delta} \geq 0$$

Similarly, when θ is **large**, *the future negative political effect of redistribution dominates its benefits through the externality. Therefore, the redistribution rate is* **lower**, *the* **larger** *is δ, the weight on the future: when $\theta > \theta_1$:*

$$\frac{d\tau}{d\delta} < 0$$

Proof: Let $D(\theta) = \frac{d(1-\tau)}{d\delta}$ be the derivative with respect to δ of (2.7). Let $N(\theta) = [\beta_1 + (1-\beta_1)(1+\theta^2\omega^2 - \theta)]^2 D(\theta)$. Then, $N(\theta) = -\theta^2\omega^2 + \theta(1+\omega) - 1$ is a concave parabola that crosses the horizontal axis first between 0 and 1 at $\theta_1 = \frac{1+\omega-\sqrt{(1-\omega)(3\omega+1)}}{2\omega^2}$, then at $\theta_2 = \frac{1+\omega+\sqrt{(1-\omega)(3\omega+1)}}{2\omega^2}$ which is higher than 1. Therefore, $N(\theta)$ is negative when θ is smaller than θ_1 and positive otherwise. The reverse is true for $\frac{d\tau}{d\delta}$.   QED.

2.3.2   Two periods in a rank-based society, $\omega(\mathbf{b_i}) = \delta\left[F(\mathbf{b_i})\right]$

In this political system, used in Bénabou[1995,1996], the political weight of the person with wealth b_i, depends on some function $\delta(.)$ of his rank $F(b_i)$[14] in society rather on his absolute wealth: $\omega(b_i) = \delta[F(b_i)]$.

Therefore, the rank r_p of the pivotal voter is just the one that satisfies:

$$\int_0^{r_p} \delta(x)dx = \int_{r_p}^1 \delta(x)dx \tag{2.8}$$

Note that r_p does not depend on the initial level of inequality. Given a function $\delta(.)$, the rank r_p is implicitly derived from (2.8), and the wealth of the pivotal voter is $b_p = F^{-1}(r_p)$, which is an inverted-U function of inequality σ, as explained in chapter one. Note from (2.8) that the rank of the pivotal voter will be the same in both periods since it does not depend on the actual distribution of income or its mean.

Since $F(b_p) = r_p$ and F(.) is a log normal distribution with mean m and variance σ^2, it is easy to show that the wealth of the decisive voter in the first period is such that $\ln b_p = m + \sigma \Phi^{-1}(r_p)$[15]. Similarly, in the second period: $\ln b_p^+ = m^+ + \sigma^+ \Phi^{-1}(r_p)$.

The chosen tax rate in the second period τ^+ will be the same as the one-period model tax rate given by equation (1.22):

$$1 - \tau^+ = \frac{\Phi^{-1}(r_p)}{\sigma^+} \tag{2.9}$$

Plugging (2.9) into the utility function of agent i given by (2.6), and maximizing the expression with respect to τ, we find that the preferred first period redistribution rate of the decisive voter whose wealth is b_p is such that:

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[14]recall that $F(.)$ is the c.d.f. of the wealth distribution.

[15]Where $\Phi(.)$ is the cumulative distribution function of the Standard Normal

$$1 - \tau = \frac{\beta_1}{1 - (1 - \beta_1)\theta} \frac{\Phi^{-1}(r_p)}{\sigma} \tag{2.10}$$

Comparing (2.10) with the one period tax rate in (1.22), we see that the only difference is the ratio $\frac{\beta_1}{1-(1-\beta_1)\theta}$ which is smaller than one. Therefore, redistribution is unambiguously higher in this non-myopic framework. The reason is that the rank and identity of the decisive voter does not change when political weight is based on rank. The politically powerful citizens in the first period will remain powerful in the second period (actually, their offsprings will) as their rank is not affected by growth or redistribution. They therefore need not fear of any future political losses of redistributing income in the first period and reducing inequality. Instead, they internalize the future benefits of early redistribution that the production externality will bring along. They will therefore favor more redistribution than if they ignored the future.

Moreover, simple partial derivatives of (2.10) lead to the following result:

Proposition 4 *The* **lower** *the externality effect (the higher θ), the* **lower** *the benefits for the offsprings of redistributing in period 1, and the* **lower** *the redistribution:*

$$\frac{d\tau}{d\theta} < 0$$

Also the **higher** *the discount rate (the higher β_1), the* **smaller** *the weight given in the lifetime utility function to the well being of the offsprings, and the* **lower** *the redistribution rate τ:*

$$\frac{d\tau}{d\beta_1} < 0$$

2.4 The general wealth-based model

While the derivations are more complex than in the one-period model, deriving the general model where no assumption is made on $\omega(.)$[16] is useful to try to understand how the shape of the later affects the balance between the two effects illustrated above using the simple log-linear wealth-based and rank-based political systems. In particular, we will show how the *slope* and the *concavity* of $\omega(.)$ affects the extent to which redistribution in the first period affects the distribution of powers in the second period.

We will follow the same methodology as in chapter one. First, we need to find what is the preferred tax rate of an individual with wealth b_i in society.

Since the b_i's are log-normally distributed, $\ln b_i \sim N(m - \frac{\sigma^2}{2}, \sigma^2)$, so will be the offsprings' endowments, y_i's, since $\ln y_i = \theta(1-\tau)\ln b_i + \theta\left(m - (1-\tau)(m - \frac{\sigma^2}{2}) - (1-\tau)^2\frac{\sigma^2}{2}\right)$:

$$\ln y_i \sim N\left[m - \theta(1-\tau)^2\frac{\sigma^2}{2} \, , \, \theta^2(1-\tau)^2\sigma^2\right]$$

Let f^+ and F^+ be the corresponding probability distribution and cumulative distribution functions, respectively. Consumption in period 2 equals production: $z_i = \hat{y}_i^\theta y^{1-\theta}$, where $y = \int_0^1 y_i di = \int_0^1 \hat{y}_i di$. Denoting τ^+ the redistribution rate in period 2, the disposable wealth of an offspring with initial wealth y_i will be:

$$\hat{y}_i = y_i^\omega \frac{\int_0^1 y_i di}{\int_0^1 y_i^\omega di}$$

Plugging this into the utility function (2.6) we find an expression for the lifetime utility of person i as a function of the chosen redistribution rate among his generation, τ, and the redistribution rate of the next generation, τ^+:

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[16]Except twice continuous differentiability

$$U_i = \left[\beta_1 + (1 - \beta_1)(1 - \tau^+)\theta\right](1 - \tau)\left(\ln b_i - m + \frac{\sigma^2}{2}\right) -$$

$$\left[1 + (1 - \beta_1)(1 - \tau^+)^2\theta^2 - (1 - \beta_1)\theta\right]\frac{(1 - \tau)^2\sigma^2}{2} \qquad (2.11)$$

The preferred first-period redistribution rate for agent i will be the τ_i that maximizes U_i in (2.11). It satisfies:

$$1 - \tau_i = \frac{\beta_1 + (1 - \beta_1)\theta\left[1 - \tau^+ + (1 - \tau_i)\frac{d\tau^+}{d\tau}|_{\tau=\tau_i}\right]}{\beta_1 + (1 - \beta_1)\theta\left[\theta(1 - \tau^+)\left[1 - \tau^+ + (1 - \tau_i)\frac{d\tau^+}{d\tau}|_{\tau=\tau_i}\right] - 1 + \frac{1}{\theta}\right]}\frac{\ln b_i - m + \frac{\sigma^2}{2}}{\sigma^2}$$

$$(2.12)$$

(2.12) gives an expression for τ_i implicitly. This is because when agent i computes what his preferred period-one tax rate τ_i would be, he takes into account the fact that this choice will affect the distribution of the offsprings endowments, y_i's, and thus the distribution of political powers in their generation, and, consequently, the tax rate τ^+ they will choose. This is captured in (2.12) in the term $\frac{d\tau^+}{d\tau}|_{\tau=\tau_i}$. For example, if $\frac{d\tau^+}{d\tau}|_{\tau=\tau_i} > 0$, it would mean that inequality affects negatively the tax rate in this political system, since a higher τ reduces period 2 inequality which translates into a higher tax rate τ^+. It is precisely this dynamics that we want to highlight, where period 1 voters take into account the effect of their vote on the distribution of wealth (and thus of political powers) of their offsprings, and consequently what choices they will make in terms of redistribution.

We can compare this preferred tax rate with the one person i preferred in the one-period model (equation (1.4)). The only difference is the first fraction in (2.12). It is of course equal to one when the offsprings welfare is ignored (i.e. $\beta_1 = 1$). It can be bigger or smaller than one depending on how the future redistribution rate varies with the current one.

When θ is high, so that the externality plays a minor role, people (above the median) will want *less* redistribution than in the myopic case because the political cost of redistribution is higher than the economic benefit. When production only depends on the externality and is the same for all ($\theta = 0$), everybody wants total redistribution to maximize their common output.

Given the most general political framework where person's i's voice has a weight $\omega(b_i)$ in society[17], the decisive voter will be the one with (log of) wealth b_p such that:

$$\int_0^{b_p} \omega(b_i)dF(b_i) = \int_{b_p}^{\infty} \omega(b_i)dF(b_i)$$

Where $F(.)$ is the cumulative distribution function of the b_i's. Similarly, the decisive voter of next generation will have (log of) wealth y_p such that:

$$\int_0^{y_p} \omega(y_i)dF^+(y_i) = \int_{y_p}^{\infty} \omega(y_i)dF^+(y_i)$$

Where $F^+(.)$ is the cumulative distribution function of the y_i's, the offsprings' endowments.

Again, for notational convenience, we will denote $\Im^+[u(y)]$ the difference in means of $u(.)$ between those below the pivotal voter ($y_i < y_p$) and those above:

$$\Im^+[u(y)] \equiv \int_0^{y_p} u(y_i)dF^+(y_i) - \int_{y_p}^{\infty} u(y_i)dF^+(y_i)$$

for any continuous function $u(y)$, so that the pivotal condition for the next generation is:

$$\Im^+[\omega(y)] = 0 \tag{2.13}$$

Since at the start of next period, voters face a one-period life, equation (1.10) of chapter

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[17]for simplicity, we will assume that nobody is excluded from the franchise. Adding a positive $\underline{b}$, will just add constant terms to these general results.

one, which gave the redistribution rate society will end up choosing, is still valid here for period 2 voters:

$$1 - \tau^+ = \frac{\ln y_p - m^+ + \frac{\sigma^{+2}}{2}}{\sigma^{+2}} \tag{2.14}$$

Where $m^+ = \theta m - (1-\tau)^2 \theta(1-\theta)\frac{\sigma^2}{2}$ and $\sigma^+ = \theta(1-\tau)\sigma$ are the parameters of the (log-normal) distribution of the offsprings' endowments y_i, expressed as a function of the first-period parameters m and σ and its redistribution rate τ

Differentiating (2.14) with respect to τ, we find that:

$$(1-\tau)\frac{d\tau^+}{d\tau} = \epsilon(y_p) - (1-\tau^+) + \frac{(1-\theta)\Im^+[x\omega'(x)] - \theta\Im^+[x^2\omega''(x)]}{2\theta y\omega(y)f^+(y)} \tag{2.15}$$

First, note the similarity of the terms in (2.15) and the terms in the derivative of b_p with respect to σ we found in chapter one (equation (1.12)). We in fact used that result to compute (2.15): a change in τ leads to a proportional change in σ^+ which affect y_p - and thus τ^+ - exactly as σ affected b_p in (1.12) in the one period myopic model. There is however a new term which involves the slope of $\omega(.)$, $\omega'(.)$ in addition to its concavity, $\omega''(.)$. This corresponds to a uniform income effect of τ on the distribution of wealth in period 2, as we explain below.

The three terms in (2.15) give interesting insights about the workings of the model. First, everything else equal, when an increase in wealth raises political power (i.e. $\epsilon(.)$, the elasticity of $\omega(.)$ with respect to wealth, is positive), redistribution in the second period will be higher, the higher the redistribution in the first period. This is because the higher this elasticity, the more political power shifts to the poor as first-period redistribution takes place. This translates in lower inequality, more power in favor of the poor when $\epsilon(.) > 0$,

and a higher τ^+ in period 2.

The second term in(2.15),$-(1 - \tau^+)$, means that the richer is the decisive voter in period 2[18], the smaller is the effect of τ on τ^+. In other terms, when τ^+ is low it means that the rich hold most of the power and they are insulated from the new middle classes that first-period redistribution will have created. Increases in τ will only modestly affect the distribution of powers and τ^+ will remain small.

The third term in (2.15) is proportional to $-\theta\Im^+\left[x^2\omega''(x)\right] + (1 - \theta)\Im^+\left[x\omega'(x)\right]$. It reflects the two opposing channels through which τ affects the income distribution in the second period. Recall from (1.17) of chapter one that the first term, $\Im^+\left[x^2\omega''(x)\right]$, measures how a rise in inequality - keeping mean income constant -affects the distribution of powers between the poor and the rich. When it is positive, it means that more inequality shifts political power to the poor, and thus a higher τ in period 1 translates in a lower τ^+ in period 2 (i.e. higher τ means smaller inequality in period 2, which means more political power to the rich, and a smaller τ^+): its effect is negative. The more we redistribute in first period, the smaller the inequality in the second period, the *richer* the second period decisive voter (because $\Im^+\left[x^2\omega''(x)\right] > 0$), and thus the *smaller* the redistribution rate τ^+. The second term, $\Im^+\left[x\omega'(x)\right]$, captures the *income* effect of redistribution in period 1 on the balance of powers in period 2. The first effect, which involved the *concavity* of the political power function $\omega(.)$, was related to the reduction in inequality consequent to a rise in τ, <u>keeping mean income constant</u>. This effect relates to the fact that a rise in τ will *increase* the mean income m^+ of the distribution of period 2 wealth y_i. Because of the concavity of the production function, a more equal distribution of b_i's will lead to a higher average output $\ln y = m^+$. The effect of this on the wealth of the decisive voter in period 2 is decreasing with $\Im^+\left[x\omega'(x)\right]$. To understand this, note that this latter term can be written as:

$$\int_0^{y_p} \epsilon(y_i)\omega(y_i)dF^+(y_i) - \int_{y_p}^\infty \epsilon(y_i)\omega(y_i)dF^+(y_i)$$

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[18]therefore, the higher $1 - \tau^+$. We are assuming that the decisive voter is richer than the median voter in both periods.

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Where $\epsilon(y_i) = \frac{y_i \omega'(y_i)}{\omega(y_i)}$ is the elasticity of political power with respect to wealth, $\omega(y_i)$ is the political weight of agent i who has wealth y_i, $F^+(.)$ is the cumulative distribution function of the incomes in period 2, and y_p is the wealth of the pivotal voter of the offsprings.

This difference captures the rise of political power of the poor (those with income smaller than y_p) compared to the power of the rich, following a uniform marginal rise of all incomes. Such marginal rise in incomes will affect marginally each political weight in the income distribution, depending on the *slope* of $\omega(.)$. If this difference is positive, then - everything else equal - an increased redistribution rate τ in period 1, by leading to a higher mean income m^+ in period 2, will move political power in favor of the poor in the second period[19], which will translate in a higher redistribution rate voted by period 2's agents, τ^+.

Note that the positive *income* effect on τ^+, proportional to $\Im^+[x\omega'(x)]$, and the negative *inequality* effect, proportional to $\Im^+[x^2\omega''(x)]$, are weighted respectively by $1 - \theta$ and θ: as the externality effect in production is relatively high (i.e. θ low), a rise in τ will have a large effect on all incomes of the offsprings, leading - if $\Im^+[.]$ is positive - to a shift of power in favor of the poor, which will lead to a higher τ^+ in period 2. This effect will dominate the negative 'inequality' effect. On the other hand, if the externality only plays a marginal role (i.e. θ high), then a rise in τ will have a small income effect on the offsprings, but it will reduce inequality among them and lead to a shift of power in favor of the rich in period 2, if the political function $\omega(.)$ is on average more concave for the poor than for the rich[20], and to a smaller τ^+.

Plugging (2.15) into (2.12) , we find that the chosen redistribution rate in the first period will be such that:

$$1 - \tau = \frac{\beta_1 + (1-\beta_1)\theta[\epsilon(y_p) + \xi^+]}{\beta_1 + (1-\beta_1)\theta\left[\theta(1-\tau^+)[\epsilon(y_p) + \xi^+] + \frac{1}{\theta} - 1\right]} \frac{\ln b_p - m + \frac{\sigma^2}{2}}{\sigma^2} \qquad (2.16)$$

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[19]Because their increase in political weight is higher than the rich's increase, given that the difference above is positive

[20]See chapter one for a discussion of this effect

With $\xi^+ = \frac{1}{2\theta\omega(y_p)y_p f^+(y_p)}\left((1-\theta)\Im^+[\omega(x)\epsilon(x)] - \theta\Im^+[x^2\omega''(x)]\right)$.

(2.16) determines τ implicitly. The term in brackets in the numerator contains terms that are function of the future distribution of income, which is itself dependent on the chosen τ. However, we can compare (2.16) with the chosen redistribution rate we found in the myopic case, (1.10). The difference is in the fraction term in front of $\frac{\ln b_p - m + \frac{\sigma^2}{2}}{\sigma^2}$. Of course, when no weight is put on the future ($\beta_1 = 1$), this ratio is equal to one and we are back in the myopic framework with the same one-period redistribution rate. When all the weight is put on future consumption ($\beta_1 = 0$), the redistribution decision in first period only entails the political and economic dynamics that will take place in the future. When θ is low and the externality effect in production is high, society will redistribute more than in the myopic case because the future benefits of a higher production externality outweighs the forgone future political power. When the externality plays a smaller role in production, the opposite will happen.

Note that when θ is close to 0, the externality dominates in production and everybody will produce the same output, in both periods. The future political cost of redistribution is very low for the elites because everybody will start the second period with almost the same income anyway. Because of this externality effect, redistribution will be higher than in the myopic case and it will be optimal ($\tau = 1$) if people put much more weight on future consumption ($\beta_1 = 0$). On the other hand, when θ is close to 1 and there is no externality effect, the costs of redistribution for the rich are higher than if they were myopic because they internalize the future political loss they will incur through additional transfers in the second period. Moreover, these costs are not counterbalanced by the future benefits of a higher externality, since $1 - \theta$ is close to zero.

To help understand how the introduction of a second period and forward looking voters affects the first period redistribution in (2.16) as compared to the myopic case given by (1.10), note that in (2.16), τ is a decreasing function of the term ξ^+[21]. This later term

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[21] i.e., the *partial* derivative of τ given by (2.16) with respect to ξ^+ is negative.

is proportional to $-\theta \Im^+ \left[x^2 \omega''(x) \right] + (1 - \theta) \Im^+ \left[x \omega'(x) \right]$ which, as we explained earlier in detail, measures the impact on the wealth of the pivotal voter of additional redistribution in period 1. When ξ^+ is high, it means that a high τ will translate into a high τ^+, as the externality effect dominates. This is costly to the political elite in the first period. They will therefore limit the redistribution despite its benefits on future productivity. When ξ^+ is small, it means that the first period redistribution will not favor too much the poor politically. These political costs are in that case outweighed by the economic benefits of a higher externality in period 2. The political elites in period 1 will therefore redistribute a lot.

While little more can be said of the implications of the model when no particular form for $\omega(.)$ is specified, the basic tradeoff between redistributing in period 1 and improve period 2's productivity, but on the other hand possibly forgoing future political weight clearly appears in this general framework. The key determinants of whether redistribution will be higher or lower when voters are non-myopic are the extent of the externality effect and the concavity of the production function θ; the weight that is put on period 2 utility $1 - \beta_1$; the shape of the political function $\omega(.)$ as measured by its slope $\omega'(.)$ and concavity $\omega''(.)$; and finally the initial level of inequality σ, as it will determine the extent of wealth redistribution for a given τ.

2.5 Redistribution and political change: two periods, franchise extension and the threat of revolution

Political change and democratization have traditionally been outcomes of the multitude of conflict of interests that exist in societies [22]. When the balance of political powers changes following a war, a period of rapid growth or some other shock, the political system adapts to aggregate the new interests. In a series of case studies of political transitions, Haggard-Kaufman[1995] illustrate how economic crises, wars, famines or other macroeconomic shocks, often trigger regime changes by affecting the distribution of powers in society,

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[22] see, for example, the models developed in and the literature review in Pierzkowsky[1993]

as well as the costs and benefits of various political options. Similarly, the shaping of the political system can help insulate the regimes from future changes. For example, Acemoglu-Robinson[1998] argue that many Western European countries extended the franchise in the nineteen century reflecting a strategic move by political elites to prevent social unrest and revolution. They in particular provide evidence of the importance of economic crises and wars in triggering such social unrest across Europe, which ultimately led governments and kingdoms to commit to irreversible large scale redistributive policies by giving-up their exclusive hold of political power and extending voting rights.

In this section, we want to investigate how future distributional conflicts and future risks of radical political change, affect the present choices in terms of political exclusion and redistribution. The model we develop relates to the political economy literature on political change, social conflict and democratization. This literature dates back to, at least, the early modern political science writings of Lipset[1959], Moore[1966] and Huntington[1968]. These discuss the origins of democracy and political change, and argue that political systems are basically the outcomes of conflicts and varying alliances between elites, masses and the middle classes. More recent work includes the models developed in Przeworski[1991], who focus on the strategic games that take place between the elites, the army and the citizen, in determining the reaction of the political system to external shocks. Closer to our model are the papers of Acemoglu-Robinson[1998,1999], Verdier[1993], Ades-Verdier[1996], Roemer[1985], Grossman[1991,1995], and Boschini[1999]

We build on the two-period model described above but allow for political change to enter the framework through franchise extension. Working in the same spirit as Acemoglu-Robinson[1997], we assume that only an elite has access to the political arena and initially decides on the redistribution rate and political change. In the early political life of the country, politics is wealth-based and an enfranchised citizen with wealth b_i has a weight b_i^ω in society. The elite has to choose to extend this wealth-based political system to all citizens, or keep the franchise limited. After that, society decides on the tax rate, and endowments are redistributed. In the second period, after production and growth have taken place, everybody becomes politically active. However, if franchise was not extended in period 1, there is a risk of a radical political change that gives equal voice to all. Extending

the franchise early is therefore a way to preserve the wealth-based structure of the political system by forgoing some but not all political power. The model goes as follows:

1. Person i is born and inherits an initial endowment of b_i. Endowments are log-normally distributed:

$$\ln b_i \sim N\left(m - \frac{\sigma^2}{2}, \sigma^2\right)$$

2. Initially, franchise is limited to those with wealth higher than $\underline{b}$. This elite decides to extend the franchise to the rest of society or not. An agent whose wealth b_i is above $\underline{b}$, has a weight $\omega(b_i) = b_i^\omega$ in the political system.

3. The enfranchised citizens decide on the progressive redistribution rate, τ. Person i ends up with wealth $\hat{b}_i = b_i^{1-\tau} \frac{\int_0^1 b_i \, di}{\int_0^1 b_i^{1-\tau} \, di}$.

4. Person i produces $2y_i = 2\hat{b}_i^\theta b^{1-\theta}$, consumes half of it and leaves the other half to her offspring.

5. An offspring i is born and inherits an initial endowment of y_i.

6. Everybody becomes politically active, but if franchise was not extended in the first period, the newly enfranchised citizen are able - with probability q - to radically reform the system and give equal voice to all, in which case total redistribution is chosen ($\tau^+ = 1$). If they are not able to revolt, or if the franchise was already extended in the first period, then the old wealth-based political system remains in place and the tax rate is set to $\tau^+ = 1 - \omega$ (the preferred tax rate of one-period societies where wealth determines log-linearly political weight, as we showed in chapter one).

7. Offspring i ends up with wealth $\hat{y}_i = y_i^{1-\tau^+} \dfrac{\int_0^1 y_i di}{\int_0^1 y_i^{1-\tau^+} di}$.

8. Offspring i produces and consumes $z_i = \hat{y}_i^{\theta} y^{1-\theta}$, where $y = \int_0^1 y_i di$.

9. Lifetime utility is unchanged: $U(b_i) = \beta_1 y_i + (1 - \beta_1)z_i$, except that agents in the first period maximize their *expected* lifetime utility when they decide not to extend the franchise, as this entails a risk of revolution in period 2.

We assume that if the franchise was extended in the first period, society inherits the old well grounded wealth-based political system. On the contrary, if the franchise was not extended, there is a probability q that a radical political change occurs and a true democracy emerges. The idea underlying this assumption is that radical political change is more likely to occur in societies where part of the population has no formal way to voice their interests. Traditional political systems are quite stable despite the fact that they are generally undemocratic and unequal. Local centers of power play a crucial role to channel demands through the traditional social structure, and these structures survive to economic changes. On the other hand, exclusive political systems are presumably more prone to radical change. We don't want to match the diverse political histories of every country with such a rigid framework, but the main theme we want to analyze is the same as in Acemoglu-Robinson[1997]: how is the decision of an elite to extend the political arena to the rest of the society to prevent itself from a possible revolution, related to the initial level of inequality, the economy and the initial political system.

To solve the model, we need to compare the lifetime utility of the decisive voter when franchise is extended in period 1, with his or her expected utility if franchise is not extended.

When franchise is extended (a scenario we index by the superscript D for Democratization, as opposed to no franchise extension, ND), then every agent's voice will count in the political process in period 2. However, since no radical political change can occur in period

2 when franchise is initially extended, wealth will still be determinant of the real political weight and the voice of an agent with wealth y_i will be worth $\omega(y_i) = y_i^{\omega}$ votes. As we derived earlier, the second period tax rate will then be $\tau^+ = 1 - \omega$.

Since franchise has been extended to all, the set-up is exactly the same as in subsection 2.3.1 above, of a two-period wealth-based political model. The first period tax rate adopted by society τ^D is given by (2.7):

$$1 - \tau^D = \frac{\beta_1 + \theta(1 - \beta_1)\omega}{\beta_1 + (1 - \beta_1)(1 + \theta^2\omega^2 - \theta)} \, \omega \tag{2.17}$$

The corresponding lifetime utility of an agent with wealth b_i is:

$$U^D(b_i) = \theta \left(\beta_1 + (1 - \beta_1)\theta\omega\right)(1 - \tau^D)\left(\ln b_i - m + \frac{\sigma^2}{2}\right) -$$

$$(1 - \tau^D)^2\theta\left[1 - (1 - \beta_1)\theta + (1 - \beta_1)\theta^2\omega^2\right]\frac{\sigma^2}{2} \tag{2.18}$$

If, on the other hand, franchise is not extended in period 1, then the expected lifetime utility of an agent with wealth b_i, at the start of the first period is:

$$EU^{ND}(b_i) = \beta_1 \ln y_i + (1 - \beta_1)q \ln z_i^R + (1 - \beta_1)(1 - q) \ln z_i^{NR}$$

Where z_i^R designates second period consumption of agent i in the case of a radical democratization or revolution R. In that case all incomes will be redistributed as the decisive voter will be the median voter who favors total redistribution: $\tau^{+R} = 1$. All offspings will have the same consumption z_i^R equal to the mean income of the offsprings, m^+:

$$\ln z_i^R = \theta m - (1 - \tau)^2\theta(1 - \theta)\frac{\sigma^2}{2}$$

z_i^{NR} is the second period consumption of agent i if no revolution took place and the old political system where wealth determines political power is still in place, even if extended to

the whole population. In that situation, the second period redistribution rate is the myopic rate we derived in chapter one, and is $\tau^{+^{NR}} = 1 - \omega$. Plugging the corresponding values in the expected utility of agent i above, and maximizing this expression with respect to τ_i, we find that the preferred first period tax rate of agent i when franchise is not extended, is:

$$1 - \tau_i^{ND} = \frac{\beta_1 + (1 - \beta_1)(1 - q)\omega\theta}{\beta_1 + (1 - \beta_1)(1 - \theta)q + (1 - \theta + \omega^2\theta^2)(1 - \beta_1)(1 - q)} \left[\frac{\ln b_i - m + \frac{\sigma^2}{2}}{\sigma^2} \right] \quad (2.19)$$

To determine what tax rate society will choose, we need to find the wealth of the decisive voter in period 1 to plug it into (2.19).

Denoting $b_p(\underline{b})$ the wealth of the decisive voter when people with wealth below $\underline{b}$ are excluded from politics, it satisfies:

$$\int_{\underline{b}}^{b_p(\underline{b})} b_i^\omega dF(b_i) = \int_{b_p(\underline{b})}^{\infty} b_i^\omega dF(b_i)$$

Given that $F(.)$ is the cumulative distribution function of a log-normal distribution, the equality above leads to[23]:

$$2\Phi\left[\frac{\ln b_p - m + \frac{\sigma^2}{2} - \omega\sigma^2}{\sigma} \right] - \Phi\left[\frac{\ln \underline{b} - m + \frac{\sigma^2}{2} - \omega\sigma^2}{\sigma} \right] = 1$$

Which leads to b_p satisfying:

$$\frac{\ln b_p - m + \frac{\sigma^2}{2}}{\sigma^2} = \omega + \frac{1}{\sigma}\Phi^{-1}\left[\frac{1}{2} + \frac{1}{2}\Phi\left(\frac{\ln \underline{b} - m + \frac{\sigma^2}{2} - \sigma^2\omega}{\sigma} \right) \right] \quad (2.20)$$

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[23]$\Phi(.)$ is the cumulative distribution function of the normal distribution

The chosen rate of redistribution in period 1 when franchise is not extended, τ^{ND} is obtained by plugging (2.20) into (2.19):

$$1 - \tau^{ND} = \frac{\beta_1 + (1 - \beta_1)(1 - q)\omega\theta}{\beta_1 + (1 - \beta_1)(1 - \theta)q + (1 - \theta + \omega^2\theta^2)(1 - \beta_1)(1 - q)} \frac{\ln b_p - m + \frac{\sigma^2}{2}}{\sigma^2} \quad (2.21)$$

We can now perform comparative statics to describe some implications of the model. In particular, we want to understand how the probability of a revolution taking place, q, affects redistribution in the first period; and how initial inequality affects the decision to extend, or not extend, the franchise.

Proposition 5 *When the first period political elite decides not to extend the franchise. the* **higher** *the probability q that political change will occur, the* **higher** *the chosen redistribution rate τ voted in the first period:*

$$\frac{d\tau^{ND}}{dq} > 0$$

The idea being that if money will not guarantee political power in the future (i.e. q high), then the attractiveness of redistributing endowments today is higher because of the externality effect next period. The political cost of redistributing is smaller since money might not matter for politics anyway, and the poor might be able to impose total redistribution in the future in any case. If this ends up being the case, everybody's consumption will be the same and will be increasing with first period redistribution, thanks to the externality.

Proof   Differentiating (2.21) with respect to q gives:

$$\frac{d(1 - \tau^{ND})}{dq} \sim -\beta_1(1 - \omega\theta) - (1 - \beta_1)(1 - \theta) < 0$$

Therefore, $\frac{\tau^{ND}}{dq} > 0$,   QED.

The expected utility of the decisive voter if she does not democratize, $EU^{ND}(b_p)$, needs to be compared with her utility $U^D(b_p)$ if their peers decide not to expand the franchise.

Replacing (2.24) and (2.20) into the expression above for $U^D(b_p)$, (2.18), we find:

$$U^D(b_p) = \theta m + \theta(1 - \tau^D)\left(\beta_1 + (1 - \beta_1)\theta\omega\right)\frac{\sigma^2}{2}\Phi^{-1}(r_p) \tag{2.22}$$

Where:

$$\Phi^{-1}(r_p) = \frac{\ln b_p - m + \frac{\sigma^2}{2}}{\sigma^2} = \omega\sigma + \Phi^{-1}\left[\frac{1}{2} + \frac{1}{2}\Phi\left(\frac{\ln \underline{b} - m + \frac{\sigma^2}{2} - \sigma^2\omega}{\sigma}\right)\right] \tag{2.23}$$

and:

$$1 - \tau^D = \frac{\beta_1 + \theta(1 - \beta_1)\omega}{\beta_1 + (1 - \beta_1)(1 + \theta^2\omega^2 - \theta)}\omega \tag{2.24}$$

Similarly, replacing (2.21), (2.19) with the $i = p$; and (2.20) in the expected utility function when franchise is not extended, we find:

$$EU^{ND}(b_p) = \theta m + A(\beta_1, \theta, \omega, q)\theta\left(1 - \tau^{ND}\right)^2\frac{\sigma^2}{2} \tag{2.25}$$

Where:

$$1 - \tau^{ND} = \frac{\beta_1 + (1 - \beta_1)(1 - q)\omega\theta}{\beta_1 + (1 - \beta_1)(1 - \theta)q + (1 - \theta + \omega^2\theta^2)(1 - \beta_1)(1 - q)}\frac{\Phi^{-1}(r_p)}{\sigma}\omega$$

and:

$$A(\beta_1, \theta, \omega, q) = \beta_1 + (1 - \beta_1)(1 - \theta)q + (1 - \theta + \omega^2\theta^2)(1 - \beta_1)(1 - q)$$

Before comparing $EU^D(b_p)$ and $EU^{ND}(b_p)$, we can perform some informing compara-

tive statics, leading to the propositions below:

Proposition 6 *The higher the probability of a radical revolution q, the lower the expected utility of not extending the franchise in period 1 and taking the risk of such a revolution occurring:*

$$\frac{\delta EU^{ND}(b_p)}{\delta q} < 0$$

Proof   The second term in (2.25) is the product of two functions of q, each of which is decreasing with q (since $\frac{d\tau^{ND}}{dq} > 0$ and the derivative with respect to q of the second term in the large parenthesis is negative, as long as $\omega < 1$). Therefore $EU^{ND}(b_p)$ is decreasing in q,   QED.

The intuition is simple: everything else equal, the more probable is a revolution to take place in period 2, the less attractive it is of not extending the franchise and not avoiding the risk of the revolution occurring. Moreover, it is intuitive and straightforward to show that this effect is stronger the more wealth-biased is the political system, as measured by σ, and the higher is the level of inequality σ. This is because these two variables make the relative cost of a radical franchise extension in period 2 higher:

$$\frac{\delta^2 EU^{ND}(b_p)}{\delta q \delta \omega} < 0$$

and,

$$\frac{\delta^2 EU^{ND}(b_p)}{\delta q \delta \sigma} < 0$$

Moreover, the model also implies the following feature of the tradeoff between redistributing and extending the franchise and risking a revolution:

Proposition 7 *When revolution in period 2 occurs with certainty (q = 1), then:*

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1. *If $\omega \leq \omega^*(\beta_1, \theta)$: the enfranchised elite will never extend the franchise in period 1, whatever the initial level of inequality σ.*

2. *If $\omega > \omega^*(\beta_1, \theta)$ and $\sigma \leq \sigma^*(1)$: the enfranchised elite will not extend the franchise in period 1.*

3. *If $\omega > \omega^*(\beta_1, \theta)$ and $\sigma > \sigma^*(1)$: the enfranchised elite will extend the franchise in period 1 to avoid the revolution.*

Moreover: $\frac{\delta \omega^*(\beta_1, \theta)}{\delta \beta_1} > 0$ and $\frac{\delta \omega^*(\beta_1, \theta)}{\delta \theta} < 0$.

Proof See appendix.

The intuition behind proposition 6 is simple. If the enfranchised elite knows for sure in period 1 that they will face a revolution in the second period if they do not extend voting rights to all, then they will assess the future costs of total redistribution in period 2 versus the cost of extending the franchise in period 1, in order to avoid the revolution. The lower ω, the less attractive it is to give up the exclusive franchise in period 1 to preserve a wealth-based political system for period 2. At the limit, when ω is very low and lower than some threshold $\omega^*(\beta_1, \theta)$, then the wealth-bias is so weak that it is close to a democratic voting process. Switching to $\omega = 0$ in period 2 is of low cost compared to extending the franchise to all in period 1. Recall that only people with wealth above some $\underline{b}$ vote in period 1. The elite has better to keep this exclusive system in the first period and move to full democracy in period 2, than moving to close-to-democracy (i.e. ω low) in both periods. Also, the threshold $\omega^*(\beta_1, \theta)$ is increasing with the discount rate $\frac{\beta_1}{1-\beta_1}$. A high discount rate reduces the net present value for the elite of the future cost of the revolution in period 2. The elite will therefore be inclined not to extend the franchise in period 1 for even higher values of ω.

When $\omega > \omega^*(\beta_1, \theta)$, then it becomes increasingly attractive for the elites to open the franchise in period 1, definitely extend the highly wealth-biased political system - even if open to all; and avoid a revolution and total redistribution in period 2. Of course, this incentive to extend the franchise to avoid the revolution will be *higher*, the higher is the level of inequality. In fact, when σ is smaller than some threshold $\sigma^*(1)$, the franchise will not be extended because, inequality being low, extending it would give similar voting power to all - even if ω is high - as incomes are not too widespread. Radical distribution in period 2 will moderately affect the distribution of income. However, having an exclusive political system in period 1 is useful for the wealthy elite, in order to avoid high redistribution in period 1. Similarly, if $\sigma > \sigma^*(1)$ and $\omega > \omega^*(\beta_1, \theta)$, then there is much to loose in period 2 if revolution takes place. The elite then have strong incentives to extend the franchise and benefit for the two periods of a highly wealth-biased political system, without running the risk of a revolution.

Proposition 8 *When the initial inequality level σ is higher than some threshold $\sigma^*(q)$, then, if $\omega > \omega^*(\beta_1, \theta)$, the elites will extend the franchise to preserve part of their future privileges, at the cost of more present redistribution.*
Moreover:

$$\frac{d\sigma^*(q)}{dq} < 0$$

Proof: See appendix.

Proposition 8 follows from propositions 6 and 7. The intuition is similar: the incentives of the elite to extend the franchise in period 1 to avoid the risk of a revolution and full redistribution are *higher*, the more wealth-biased is the political system and the higher the inequality. When the level of inequality is higher than a given threshold $\sigma^*(q) < \sigma(1)$, then it becomes profitable for the elites to extend franchise in period 1 to keep the wealth-biasedness of the system and avoid a radical redistribution in period 2. Below that level, future redistribution will not affect that much the income distribution, and the elite will prefer to hold to their period 1 exclusive political system rather than extend voting rights to

all in period 1. Moreover, the higher q, the higher the incentives of extending the franchise and try to avoid a more likely revolution. Therefore, the threshold of inequality $\sigma^*(q)$ above which franchise is to be extended, is lower, the higher q.

One implication of this simple model of inequality, redistribution and political change is that early democratization is most likely to occur, the higher is initial inequality. While more formal cross country tests should be performed, case study evidence from the nineteenth and twentieth century seem to support that implication: unequal societies in Latin America have had franchise extensions early in the century (while often reverting to dictatorships during limited episodes of time, as documented in Acemoglu-Robinson[1999]). In contrast, most of the more equal African countries are still under the rule of a dictatorial or non-democratic regimes. Moreover, when looking at 19th century Europe, more equal countries like Germany extended the franchise much later than the more unequal France and England (where episodes of social unrest were also more frequent).

It's effect is of course harder to measure than inequality, but one might be tempted to question whether the increases of the number of officially democratic countries in the eighties and nineties (with no corresponding increases in social transfers or redistribution as we observed in England and France after franchise extension in the 19th century. The opposite actually happened) is simply due to some increase in ω and a much steeper relation between wealth and political power[24].

2.6   Concluding remarks and extensions

In this chapter, we developed a *partly* dynamic political economy model of redistribution that tries to capture some of the tradeoffs elites face in deciding on redistributive policies. We showed how the prospect of a lower political weight in the future affects the amount of wealth redistribution they will choose. The model is only partly dynamic because the second

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[24]Modernization might explain it, the fall of traditional political structures as well, finally the increased role of education and wealth in modern political systems

period voters are myopic and the life of the model ends after two periods. To our knowledge, there no fully dynamic political economy models in the literature. Our assumption is that having more than two periods, would lead to continuum of political equilibria rather than the clear cut outcome we obtained in our model. Bénabou[1999], that inspired much of this work, has a model of infinitely-lived agents, but is only able to avoid this problem by looking for equilibria where, precisely, marginal changes of the tax rate in one period does not affect the distribution of incomes in the next period. Bourguignon-Verdier[1997] study a non-overlapping generations political-economy model of democratization and growth, but assume that a given generation only cares about the next generation's wealth instead of utility, so they *de facto* have a series of two-period models.

It is worth noting that this class of one dimensional distributional conflicts can potentially explain why societies choose different *amounts* of redistribution. However, countries differ greatly in the *types* of redistributive schemes they adopt. This might just be due to various technological constraints. Poorer countries might not be able to tax wage income or profits and redistribute them efficiently to the poor, while imposing a tariff or hiring extra workers in the public sector might be easier to do. There is no doubt that these constraints which should be relaxed in the course of economic development could potentially explain part of the puzzle. However, there might be a political economy explanation to it as well. Assuming that wealth gives political power, then, as we argued in this chapter, redistributing it adversely affects the political weight of the elites in the future. Provided that voters are forward looking, the elites might oppose otherwise efficient redistributions just for the sake of preserving their political advantage. Alternatively, if the elites choose which redistributive scheme to use, they might as well use the less costly instruments in terms of political power, in case the redistributive pressure is too high.

There are indeed numerous examples in the third world where the government transfers are actually high, but the redistributive mechanisms used are very inefficient: high public sector wages, high agricultural prices, import tariffs, over-employment in the public sector, over-spending in higher education relative to primary education, etc. All of these are quite inefficient redistributions compared to investment in public infrastructures in poor areas, investment in primary education, basic health and vaccination etc. The idea is that the

later are much more costly in terms of foregone future political weight, because they are much more likely to permanently affect the income distribution, and hence the distribution of political powers. It would be interesting to extend our framework along these lines and to allow for another dimension in the wealth endowments of individuals.

Finally, it is important to note that our model excludes the possibility that wealthy agents invest their own resources to increase their political voice. Such a model of political contributions would certainly alter some of our findings, as changes in the income distribution would affect the amount of political contributions and the political outcome at equilibrium, in addition to the effects we described.

2.7 Appendix

2.7.1 Proof of propositions 7 and 8

First note that when $q = 0$, revolution will never occur and therefore, there is no reason for the elite to extend franchise in period 1: $EU_{q=0}^{ND}(b_p) > U^D(b_p)$. We also showed that $EU_q^{ND}(b_p)$ was strictly decreasing with q.

Now, starting first with the case were revolution will occur with certainty, $q = 1$, we want to compare $EU_{q=1}^{ND}(b_p)$ with $U^D(b_p)$. Replacing with the appropriate values, we find that the difference $EU_{q=1}^{ND}(b_p) - U^D(b_p)$ is proportional to:

$$h(\beta_1, \theta, \omega)\theta(1 - \tau^D) + \sigma^2\Phi^{-1}(r_p)\left(l(\beta, \theta) - h(\beta_1, \theta, \omega)\theta(1 - \tau^D)\right) \qquad (2.26)$$

Where:

$$l(\beta_1, \theta) = \frac{\theta\beta_1^2}{2\left(\beta_1 + (1 - \beta_1)(1 - \theta)\right)}$$

and $h(\beta_1, \theta, \omega) = \beta_1 + (1 - \beta_1)\theta\omega$.

$\Phi^{-1}(r_p)$ and $(1 - \tau^D)$ were given previously by equations (2.23) and (2.24) respectively.

From the analysis in chapter one, we know that $\sigma^2 \Phi^{-1}(r_p)$ is an increasing function of σ.

Proposition 7 follows from the fact that $h(\beta, \theta, \omega)(1 - \tau^D)$ is strictly increasing with ω. In particular, let $\omega^*(\beta, \theta)$ be the value of ω for which $l(\beta_1, \theta) - h(\beta_1, \theta, \omega)\theta(1 - \tau^D) = 0$. Then, for $\omega < \omega^*(\beta, \theta)$, the second term in the difference (2.26) is positive, and $EU_{q=1}^{ND}(b_p)$ will be higher than $U^D(b_p)$ for all values of σ. On the other hand, if $\omega > \omega^*(\beta, \theta)$, the second term in difference (2.26) will be negative and will likely dominate the first term when $\sigma^2 \Phi^{-1}(r_p)$ is large enough, i.e. when σ is higher than some threshold $\sigma^*(1)$ such that:

$$h(\beta_1, \theta, \omega)\theta(1 - \tau^D) + \sigma^{*^2}(1)\Phi^{-1}(r_p)\left[l(\beta_1, \theta) - h(\beta_1, \theta, \omega)\theta(1 - \tau^D)\right] = 0$$

Graphically:
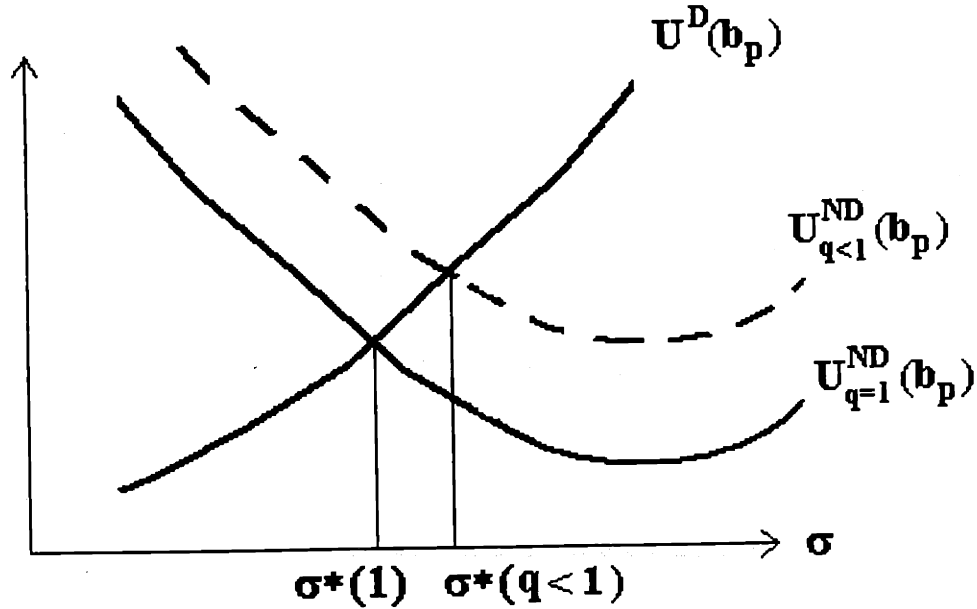
Since $U^D(b_p)$ does not depend on q; $U_q^{ND}(b_p)$ is strictly decreasing in q for every value of σ; and finally, since the $U^D(b_p)$ is strictly increasing with σ, the threshold $\sigma^*(q)$ will be higher than $\sigma^*(1)$ for values of q smaller than one: $\frac{d\sigma^*(q)}{dq} < 0$, QED.

Chapter 3

Evidence on growth, the income distribution and redistribution

3.1 Abstract

This chapter provides new insights on the relationship between economic growth, redistribution and the income distribution. We use an extended version of Dollar-Kraay [2000] dataset and show that growth affects the income distribution unevenly. We first reproduce their finding that the income share of the first quintile is unaffected by growth, and find that it is also the case for the second quintile. We then apply the same analysis to other parts of the income distribution and find that growth *improves* the *income share* of the middle portion of the income distribution (third and fourth quintiles) while it *reduces* the *income share* of the upper quintile of the population. Consistent with this result, we find that the Gini coefficient is negatively related to growth. One possible explanation of these findings is that redistribution is disproportionally benefiting the middle classes, so that their share of income might actually raise with growth. We indeed find that, controlling for average income, the income shares of the third and fourth quintiles *increase* with two measures of redistribution (government consumption, and social expenditures), the income share of the top quintile *decreases* with redistribution, while the income shares of the first and second quintiles are not affected by redistribution. Education expenditures have an equal (possibly null) effect on all parts of the income distribution.

3.2 Introduction

The question of how inequality is generated and how it reproduces over time has been a major concern for economists and social scientists for more than a century. Yet, this relationship is far from being clear and well understood. There do not seem to be universal trends in this relation. For example, Atkinson [1996] illustrates the diversity of experiences in a number of industrial economies, all at similar levels of development and experiencing similar rates of growth. He found that the Gini coefficient of (gross) household income has increased sharply in the U.S.A. and in the U.K., remained roughly constant in Germany and decreased in France, Italy and Canada. The changes in income inequality in a country are not solely shaped by economic forces, the rate of growth, inflation and macroeconomic stability but also by social and political forces. In particular, government transfers, which are the second largest source of household income (Atkinson [1997]), presumably have a significant effect on inequality. In fact, several authors have found that growth and inequality are not related in the cross-country evidence (for example Deininger-Squire[1996], Chen-Ravallion[1997], Bruno-Ravalion-Squire[1996] and Easterly[1999]).

This chapter builds on Dollar-Kraay[2000] work on growth and poverty (D-K hereafter). They show that growth raises the income of the poor by as much as it raises the mean income and claim that "*the rich, the poor and the country as a whole are all seeing their income rise simultaneously at about the same rate*". Dollar and Kraay studied the relationship between the income of the bottom fifth of the population, the first quintile, and per capita GDP, in a sample of 80 countries covering four decades. They also show that the effect of growth on income of the poor is no different in poor countries than in rich ones, that incomes of the poor do not fall more than proportionately during economic crises and that the poverty-growth relationship has not changed in recent years.

We start by reproducing some of their results using an extended dataset that includes sub-Saharan African countries, most of which were excluded from the D-K analysis. Also we use a measure of the income *share* that accrues to the first quintile to test whether their result was just due to the way they constructed the average income of the first quintile.

Using these alternative datasets and variables, we find that, indeed, the average income of the first quintile moves, on average, one-for-one with mean income; and that the share of income that accrues to the first quintile is not affected by changes in GDP.

We then test whether this applies to the rest of the income distribution and first assess how income inequality is affected by growth. We find a strong negative relation between growth and the Gini coefficient in the cross-country variation. This finding seems to be robust to various specifications and datasets. Since we confirmed D-K's results and found that the incomes of the first quintile move proportionally to GDP, it must be that growth affects differently other groups of incomes, for overall inequality to be reduced.

We test this hypothesis by extending the Dollar-Kraay analysis to the other quintiles of the income distribution, to see whether different shares of income evolve equally with growth or not. This approach of running separate growth regressions for different quintiles of the income distribution contributes to the small and recent literature that tries to understand the determinants of the income of the poor[1]. For example, Lundberg-Squire[1999] find that there is more variation in the relation between various policies to incomes per quintile than to aggregate income. They also find that expanded education increases growth significantly among the poor (bottom 40% of the population), while reducing it significantly among the rich (top 20% of the population). Finally, they find that the Sachs-Warner openness index[2] is negatively correlated with growth among the poorest 40% and positively correlated with the 40% wealthiest.

We find evidence that growth *reduces* the income share of the top quintile, *increases* the income shares of the third and fourth quintiles, while it keeps unchanged the income shares of the first and second quintiles. Growth seems to benefit more the "middle classes" than the top and bottom quintiles. This result is consistent with the findings of Lundberg-Squire[1999] on the effect of various policies on the middle classes. Moreover, this decomposition of the effect of growth on different parts of the income distribution is consistent with the finding that overall inequality seems to be reduced by economic growth, as the top

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[1]See, for example, Anderson-Knack[1999] and Lundberg-Squire[1999]
[2]See Sachs-Warner[1995]

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quintile seems to be benefiting less than other quintiles.

One mechanism that could potentially explain this uneven distribution of the benefits of growth is redistribution. If social transfers or other redistributive benefits like education are disproportionally benefiting the middle-classes (an implication of many political economy models, including those based on the medium voter theorem), then growth episodes could increase their share in total income either mechanically because of progressive taxation or because pressure to increase redistribution is stronger when an economy is growing, and pressure to reduce it increases during recessions.

We provide indirect evidence to test this hypothesis by including proxies for redistribution as determinants of the shares of incomes of different quintiles. Using government consumption as a share of GDP, education expenditures as a share of GDP, and social expenditures as a share of GDP as redistribution measures, we find that, controlling for average income, the income share of the "middle classes" (third and fourth quintiles) *rise* with all three measures of redistribution, the income share of the top quintile *decreases* with redistribution, and the income share of the first and second quintiles are, on average, unaffected by redistribution. To our knowledge, this work, together with Lundberg-Squire[1999]'s, are new cross-country evidence that redistributive policies are biased towards the middle classes.

The remainder of the chapter is organized as follows. The next section describes the data used in this analysis. Section 3.4 describes the empirical methodology used throughout the chapter. Section 3.5 presents our results on the effect of growth on different parts of the income distribution. Section 3.6 shows how redistribution affects differently the average incomes and income shares of different quintiles of the income distribution, providing one possible explanation of why benefits from growth seem to be unevenly distributed in the population. Section 3.7 concludes.

3.3 The data

Most of the data for real GDP, Gini coefficients and incomes of the poor, except for the sub-Saharan countries, is taken from the data set compiled by Dollar and Kraay. They used the Summers and Heston Penn World Tables 5.6 which reports data on real per capita GDP, adjusted for differences in purchasing power parity for most of the 156 countries covered by the data set, up until 1992. To extend it to 1997, they used growth rates of constant price local currency per capita GDP from the World Bank World Development Indicators. For a further set of 29 countries, mostly 'transition' economies not included in the Penn World tables, they used World Bank data on constant price GDP in local currency units. Other control variables that we used such as government consumption ratios, education expenditures, social spending and primary school enrollment, are from the World Bank 2000 Economic Indicators data set, covering the period 1960 to 1998. For estimates of the incomes of various quintiles of the distribution, we start from the same dataset as D-K, which is an augmented version of the Deininger-Squire [1996] dataset, Lundberg-Squire[1999] and the World Bank Development indicators for 1999 and 2000.

We restricted the analysis to the subset of income distribution data that are referred as *high quality* by Deininger and Squire, except for a subset of thirteen sub-Saharan countries that were not included in D-K. The grounds for exclusion from the *high-quality* set include the survey being of less than national coverage; the basing of information on estimates derived from national accounts rather than from a direct survey of incomes; the limitations of the sample to the income earning population; and derivation of results from non-representative tax records. Data are also excluded from the high-quality set if there is no clear reference to the primary source. This reduces considerably the set of observations, and excludes all but 4 sub-Saharan countries from the D-K analysis, out of their 77-country sample. We decided to include thirteen additional countries from sub-Saharan Africa not identified as *high-quality*, to test the validity of their results. We however excluded SSA countries for which inequality was not measured based on direct surveys of incomes or those that are not based on national surveys. The sample of SSA countries includes 5 to 25 year-observations per country, but only a few of them with spacing of at least 5 years.

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In addition to the Gini coefficient, we need the average income and the income shares of the five quintiles of the income distribution. For 339 out of 457 high quality country-year observations, we have 4 points on the Lorenz curve, so we are able to measure directly the average incomes per quintile. For the remaining 118 observations, we use a similar approach as D-K and infer the Lorenz curve quintile points from the Gini coefficient assuming that the income distributions are log-normal. Following Quah[1999], the cumulative quintile shares of a log-normal distribution with variance σ^2 is:

$$S_{0.2i} = \Phi \left[\frac{\Phi^{-1}(0.2i)}{\sigma} - 1 \right]$$

With $i = 1$ to 5 is the quintile and $\Phi(.)$ is the cumulative distribution function of the standard normal distribution.

The standard deviation σ can then be inferred from the data on the Gini coefficient G (a number between 0 and 1) which, for a log-normal distribution with standard deviation σ is expressed by:

$$G = 2\Phi \left(\frac{\sigma}{\sqrt{2}} \right) - 1$$

Combining these two equations leads to the following expression for the cumulative quintile shares as a function of the Gini coefficient:

$$S_{0.2i} = \Phi \left[\frac{\Phi^{-1}(0.2i)}{\sqrt{2}\, \Phi^{-1}\left(\frac{1+G}{2}\right)} - 1 \right] \tag{3.1}$$

From these series, we construct the shares of income accruing to each quintile by taking first differences in the cumulative shares. From a set of about 2,600 observations in the original data set of Deininger-Squire[1996], we filtered the data to a set of 457 observations. Following D-K, we work with an irregularly spaced panel using actual years to which

the surveys refer. For the data points we are adding to their dataset, we use the same methodology they use to filter the data. For each country, we begin with the first available distribution observation. Moving forward in time, we then choose the next observation subject to the constraint that at least five years separate observations, until the available data for the country is exhausted. This results in an unbalanced and irregularly spaced panel of 457 observations on Ginis and mean income of the five quintiles of the income distribution, separated by at least five years within countries. Out of these 457 country-years, 339 have quintile average incomes derived directly from the Lorenz curve points available and the remainder are estimated using the log-normal approximation given by equation (3.1). The whole dataset covers a total of 138 countries. To be able to consider within-country growth of per-quintile mean income, we need to restrict further the sample and exclude countries that do not have at least two observations spaced by at least five years. We end up with 303 country-years covering 87 countries (compared to 236 country-years covering 80 countries in the D-K study).

3.4   Empirical Methodology

Throughout the chapter, we will estimate variants of the following two regressions for each of the five quintiles of the income distribution:

$$y_{c,t}^i = \alpha_0^i + \alpha_1^i y_{c,t} + \alpha_2^i X_{c,t} + \mu_c^i + \epsilon_{c,t}^i \tag{3.2}$$

$$s_{c,t}^i = \beta_0^i + \beta_1^i y_{c,t} + \beta_2^i X_{c,t} + \theta_c^i + \nu_{c,t}^i \tag{3.3}$$

Where:

c and t index countries and years respectively

$i = 1$ to 5 index the quintile for which the regression is estimated

$y_{c,t}$ is the logarithm of mean income in country c in year t

$X_{c,t}$ are a set of explanatory variables that affect directly the incomes of each quintile *on*

top of their direct effect through average income

$y_{c,t}^i$ measures the logarithm of the average income of the population which is in the i-th quintile of the income distribution

$s_{c,t}^i$ measures the *share* of national income that accrues to the i-th quintile of the income distribution (i.e. $y_{c,t}^i = 5.s_{c,t}^i y_{c,t}$)

μ_c^i and θ_c^i are country-quintile specific random terms

$\epsilon_{c,t}^i$ and $\nu_{c,t}^i$ are country-year-quintile random terms

In equation (3.2), α_1^i measures the elasticity of the income of the i-th quintile with respect to mean income. In equation (3.3), β_1^i measures the elasticity of the share accruing to the i-th quintile, with respect to mean income.

The standard hypothesis that we will test in the paper is whether the incomes of the different parts of the income distribution move one-for-one with overall GDP. In other words, we will test the following Null hypothesis:

H$_0$: $\alpha_1^1 = \alpha_1^2 = \alpha_1^3 = \alpha_1^4 = \alpha_1^5 = 1$

And, alternatively:

H$_0$': $\beta_1^1 = \beta_1^2 = \beta_1^3 = \beta_1^4 = \beta_1^5 = 0$

Two differences and new contributions with respect to the Dollar-Kraay[2001] paper need to be highlighted:

First, as stated in the introduction, we want to study the effect of growth on the five quintiles of the income distribution and not only focus on the poor or the first quintile. Second, we want to use the income *shares* of each quintile as dependant variables in addition to their average incomes. This is indeed what we ultimately want to measure: how GDP changes affect the income shares of the different quintiles. In fact, if $\beta_1' \neq 0$ in equation (3.3), then the "average-income" equation (3.2) will be misspecified and its estimates will be biased.

The other estimates of interest are α_2^i" and β_2^i" which measure the effect of other determinants of growth (including primary school enrollment, government consumption, expenditures in education, social spending etc.) on the average income of quintile i and the share of income accruing to that quintile, *in addition to their direct effect* on mean income. We will not focus on the other policy variables analyzed in D-K, but rather test whether these variables, that we consider as good proxies for redistribution, affect the income distribution unevenly[3].

Of course OLS and GLS estimation of (3.2) and (3.3) will certainly lead to biased estimates of the regression coefficients. This is due to the usual problems associated with cross-country regressions. First, measurement errors in $y_{c,t}$ and $y_{c,t}^i$ in (3.2) are likely to be correlated. This will be mitigated by the instruments we use[4]. Moreover, since we are also estimating how the *shares* in income respond to average income in equation (3.3), we will be able to check the validity of our estimates from equation (3.2), with the confidence that measurement errors in $s_{c,t}^i$ and $y_{c,t}$ are less likely to be correlated. Another problem is of course that both specifications (3.2) and (3.3) certainly omit to include unobserved variables that are likely to affect both the distribution of income and average income (as well as some variables in $X_{c,t}$). Finally, the distribution of income and growth are likely to be jointly determined. In the absence of good instruments, there is little we could do to overcome these problems.

To get rid of any time-invariant country-specific sources of heterogeneity likely to be correlated with mean income and $X_{c,t}$, we will estimate first-difference versions of (3.2) and (3.3):

$$\Delta y_{c,t}^i = \alpha_1^i \Delta y_{c,t} + \alpha_2^i \Delta X_{c,t} + \Delta \epsilon_{c,t} \tag{3.4}$$

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[3]We tried to subtract from government consumption public expenditures that are clearly not redistributive (in particular military expenditures), but there was too limited cross-country and time-series data available for these variables

[4]D-K argue in their appendix that the OLS bias should be limited, under plausible assumptions on the form of measurement error

$$\Delta s_{c,t}^i = \beta_1^i \Delta y_{c,t} + \beta_2^i \Delta X_{c,t} + \Delta \nu_{c,t} \qquad (3.5)$$

Where $\Delta y_{c,t}^i = y_{c,t}^i - y_{c,t-\delta(c,t)}^i$ (and similarly with the other variables) and $\delta(c,t)$ is the country-year specific time lag between country observations, which is at least five years.

The problem with estimating these first-difference equations is that we are using a more limited time-series variation in incomes and income distributions to identify our relationships. In contrast, the level estimations in equations (3.2) and (3.3) allow us to benefit from the large cross-country variation in incomes, inequality and other $X_{c,t}$ variables, at the cost of a potentially more severe omitted variable problem, due in particular to country-specific time-invariant omitted variables. D-K go about solving this dilemma by implementing a system estimator that identifies α_1^i and α_2^i' ($i = 1$ in their case) by jointly estimating (3.2) and (3.4) as a system under the restriction that the coefficients in both regressions be equal. Throughout their paper, the level, first difference and system estimates did not show major differences. We will focus on estimating (3.2), (3.3), (3.4) and (3.5) and ignore the system estimation. Finally, we will mitigate the problems of measurement error, omitted variables and endogeneity by using lagged explanatory variables as instruments. In particular, we will instrument mean income with the growth of GDP over the five years prior to time t.

3.5 The Effect of growth on different parts of the income distribution

3.5.1 Growth and the Income of the Poor

We will start by focusing on the first quintile to compare our estimates with the findings of Dollar-Kraay[2001]. As described in section 3.3, we are including additional country-years. Also, we are measuring directly the impact of growth on the *share* of income accruing to the poor (equation (3.3)) which should constitute a check of robustness of their results (which derive from equation (3.2) only).

To see whether inferring the Lorenz curve points from the Gini coefficients when the former are not available is affecting in any way the results, we first estimate equations (3.2), (3.3), (3.4) and (3.5) using the D-K countries and years but restricting to only those observations for which the Lorenz curve points of the income distribution are directly available. This excludes some 15 per cent of the country-years. We would like to first test the hypothesis with directly observable data and compare that to the extended dataset. The second estimation include all the country-years of D-K, whether the Lorenz curve points were available or not. The third estimation adds the 7 sub-Saharan countries for which we have sufficient income distribution data, even if of lower quality than the other countries. The idea is to check whether omitting all but a few sub-Saharan countries biased D-K's results.

Table 1 on the next page shows the basic specification where we regress the log of average per capita income of the first quintile (the 'poor' in D-K) on the log of average per capita income. The other control variables included in the level regressions are six regional dummies [5]. The estimates for the regional dummies are not presented for clarity. Significance varies from one regression to the other, but the dummies for Sub-Saharan Africa and Latin America are consistently significant.

We present the results for the three datasets described above. The D-K study used the dataset under column (II) in table 1. We show the results for three regression analysis. The first one (OLS), is an ordinary least square regression pooling all of the country-year observations together. The second one (GLS RE) is a country random effect panel regression of the standard specification. The third one (IV) is a 2SLS instrumental variable estimation using the average growth rate of GDP over the five past years prior to date t, as an instrument for GDP at date t. Standard errors were corrected for heteroskedasticity and for first-order autocorrelation in the first-difference estimations, using a standard Newey-West procedure.

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[5]Latin America, Sub-Saharan Africa, East-Asia and Pacific, Europe and Central-Asia, Middle-East and North-Africa, South-Asia

Table 1: Growth Elasticity of the Income of the Poor

Level estimation - equation (3.2)

Dependant variable: Log of average income in the first quintile of the income distribution

	(I)			(II) – 'D-K'			(III)		
	OLS	GLS RE	IV	OLS	GLS RE	IV	OLS	GLS RE	IV
Intercept	-1.82 (0.23)	-1.85 (0.39)	-0.89 (3.49)	-1.81 (0.22)	-1.99 (0.20)	-0.86 (3.45)	-1.91 (0.18)	-1.97 (0.19)	-0.82 (3.41)
Log(GDP)	**1.07 (0.02)**	**1.09 (0.04)**	**0.94 (0.33)**	**1.07 (0.02)**	**1.08 (0.04)**	**0.94 (0.32)**	**1.06 (0.02)**	**1.06 (0.03)**	**0.96 (0.31)**
P-value (H$_0$)	0.001***	0.021**	0.391	0.001***	0.054*	0.387	0.004***	0.057*	0.381
R-squared	0.89	0.86	0.82	0.89	0.86	0.82	0.89	0.86	0.82
# of obs.	201	201	187	236	236	219	303	303	281
# countries	78	78	78	80	80	80	87	87	87

Other control variables included are 6 regional dummies for Latin America, Sub-Saharan Africa, East-Asia and Pacific, Europe and Central-Asia, Middle-East and North-Africa and South-Asia.

OLS is an Ordinary Least Square estimate, pooling all of the country-year observations together.

GLS RE estimates are country random-effect panel estimates of the standard specification.

IV are 2SLS Instrumental Variable estimates, using the growth rate of real GDP over the past five years as instrument for Log(GDP). All variables are in per-capita terms

Standard errors are in parentheses. They are corrected for heteroskedasticity.

*: the null hypothesis of a slope coefficient equal to one can be rejected with 90% confidence. **: 95% confidence. ***: 99% confidence

Column (I) includes D-K data points except those for which Lorenz curve points were not available.

Column (II) includes all D-K data points, including those where Lorenz curve points were not available.

Column (III) includes all D-K data points and other data from 7 sub-Saharan countries.

The first conclusion we can draw from running these regressions on the three datasets (I), (II) and (III), is that they all give roughly the same point estimates and standard errors. When testing for the equality of means between the OLS point estimates in datasets (I) and (II), we cannot reject the null hypothesis of the same mean with a p-value of 0.37. Similarly, for the GLS RE and IV 2SLS estimates across samples (I), (II) and (III), the mean point estimates are not significantly different. Including the data for which the Lorenz curve points were derived from the Gini coefficients does not affect our estimation. Also, including seven additional sub-Saharan countries which have somewhat less reliable income distribution data, increases our sample size from 236 to 303, without significantly affecting the estimates. We will therefore focus on data sample (III) for table 1.

The OLS regression gives a point estimate of the elasticity of the income of the poor (i.e. the first quintile) with respect to GDP per capita of 1.06. This is significantly greater than 1. However, the standard error is likely to be underestimated. The country random effect estimation lead to a point estimate of 1.08 which is still significantly greater than 1. However, the estimated standard error more than doubled compared to OLS and we can reject the null hypothesis of an elasticity of one only with 90% confidence. When we instrument for GDP using growth of GDP over the past five years, the point estimate of the elasticity falls to 0.96 which is not significantly different than 1, as the estimated standard error increased almost eight-fold compared to the random effect estimates. As Dollar and Kraay argue, this is probably due to the fact that average past growth of GDP is not a good instrument for GDP.

Table 2 below shows the same regressions on the three samples but after first differencing the variables [6]. The instrument that is used for the first difference in $log(GDP)$ is now the previous first difference in $log(GDP)$. This will likely perform better as an instrument than in the level estimation case. For all three samples, the OLS and IV point estimates of elasticity are not significantly different than 1, ranging between 0.972 for the IV-estimate to 1.002 for the OLS estimate, both in sample III. First-differencing reduced the estimated standard error of the IV estimator, certainly because past growth rate is a much better

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[6]First differencing cancels out the country-specific error terms, leaving us with only OLS and IV estimations

predictor of future growth rate than it is for future GDP. These results are very close to the estimates found by D-K, suggesting that the average income of the first quintile is indeed moving close to one-for-one with overall GDP. As the three samples give similar results, we will work with the full dataset III in the remaining of the chapter.

As noted in section 3.4, we want to test the robustness of these results by using the share of income accruing to the first quintile as a dependant variable instead of the average income. Recall that the data on income distribution provides the shares directly, while the average incomes were computed by multiplying the share by $5.y$, where y, mean income, is the explanatory variable.

Table 3 on the next page shows the results of both the level and first-difference regressions (3.3) and (3.5). The results are in fact stronger than when we used the average income of the first quintile as a dependant variable. The estimates of the elasticity of the income share of the first quintile with respect to (log of) GDP are not significantly different than zero for the OLS level regression (p-value 0.654), the random effect regression (p-value 0.712), the IV level regression (p-value 0.688), the OLS difference regression (p-value 0.593) and the IV difference regression (p-value 0.580). All of the estimates point in the same direction: growth does not significantly affect the income share of the first quintile.

Of course, one should interpret these results with caution. First, the data available limits what we can say about the very poor - the bottom 5% or 10% poorest in the income distribution. There could be some distribution dynamics inside quintiles that our analysis is missing. Moreover, our data on income distribution form a highly unbalanced and irregularly spaced panel of country-year observations. For most countries, only a few year observations are available. Keeping this in mind, we will use the same dataset (III) and the same specifications in the next subsection to test whether overall inequality is at all affected by growth.

Table 2: Growth Elasticity of the Income of the Poor

First difference estimation – equation (3.4)

Dependant variable: First difference of the log of average income in the first quintile of the income distribution

	(I)		(II) – 'D-K'		(III)	
	OLS	IV	OLS	IV	OLS	IV
Δ(Log(GDP))	0.981 (0.059)	0.904 (0.071)	0.974 (0.051)	0.922 (0.074)	1.002 (0.050)	0.972 (0.074)
P-value (H_0)	0.390	0.274	0.379	0.316	0.399	0.387
R-squared	0.14	0.17	0.12	0.13	0.10	0.11
# of obs.	199	185	234	217	299	277
# countries	78	78	80	80	87	87

Δ(Log(GDP)) is the first difference of log(GDP)

OLS is an Ordinary Least Square estimate, pooling all of the country-year observations together

IV are 2SLS Instrumental Variable estimates, using as instrument the growth rate of real GDP over the past five years prior to the year of the lagged value of Log(GDP). All variables are in per-capita terms

Standard errors are in parentheses. They are corrected for heteroskedasticity and for first-order autocorrelation using the Newey-West procedure

*: the null hypothesis of a slope coefficient equal to one can be rejected with 90% confidence. **: 95% confidence. ***: 99% confidence

Column (I) includes D-K data points except those for which Lorenz curve points were not available

Column (II) includes all D-K data points, including those where Lorenz curve points were not available

Column (III) includes all D-K data points and other data from 7 sub-Saharan countries

Table 3: Growth Elasticity of the Share of Income accruing to the Poor

Dependant variable:	Equation (3.3) - level Share of income accruing to the first quintile			Equation (3.5) - differences First difference in the share of income accruing to the first quintile	
	<u>OLS</u>	<u>GLS RE</u>	<u>IV</u>	<u>OLS</u>	<u>IV</u>
Intercept	0.0018 (0.35)	0.0027 (0.44)	0.0102 (0.71)		
Log(GDP) [*first diff.*]	**-0.0008** **(0.002)**	**-0.0002** **(0.003)**	**-0.0052** **(0.017)**	**-0.0004** **(0.004)**	**-0.0060** **(0.010)**
P-value (H_0')	0.654	0.712	0.688	0.593	0.580
R-squared	0.01	0.01	0.01	0.01	0.01
# of obs.	303	303	281	299	277
# countries	87	87	87	87	87

Other control variables included in the level regressions are 6 regional dummies for Latin America, Sub-Saharan Africa, East-Asia and Pacific, Europe and Central-Asia, Middle-East and North-Africa and South-Asia.
OLS is an Ordinary Least Square estimate, pooling all of the country-year observations together.
GLS RE estimates are country random-effect panel estimates of the standard specification.
IV are 2SLS Instrumental Variable estimates, using the growth rate of real GDP over the past five years as instrument for Log(GDP). All variables are in per-capita terms
Standard errors are in parentheses. They are corrected for heteroskedasticity and for first-order autocorrelation in the difference equations, using the Newey-West procedure
*: the null hypothesis of a slope coefficient equal to zero can be rejected with 90% confidence. **: 95% confidence. ***: 99% confidence

3.5.2 Growth and overall Inequality

Before looking at the other parts of the income distribution, we want to use the same specification, dataset and regressions to verify whether growth affects the overall distribution of income or not. Inferring from their results on the first quintile, D-F argue that all incomes move one-for-one with mean income, and therefore growth does not affect inequality.

Table 4 of the next page summarizes the results of regressing the Gini coefficient on the log of GDP, controlling for the same six regional dummies described earlier. Surprisingly, whatever specification we use, controls we include, or dataset we select, we consistently find that inequality is negatively associated with growth. The OLS slope coefficient of -0.0276 is significantly smaller than zero at the 99% level of confidence. The GLS country random effect estimate is -0.022 and is also significant at the 99% level. Instrumenting for GDP with the lagged GDP and the average growth rate of GDP over the previous five years, increases the coefficient to -0.065 but statistical significance is lost, most probably because the instruments used are poor determinants of GDP. The first-difference estimations give higher coefficients, all of them are negative and statistically significant: -0.072 for OLS (p-value 0.001) and -0.079 (p-value 0.001) for the instrumental variable 2SLS. Again, the growth instrument is clearly more valid in the first-difference specification, when country-specific random terms are evened out.

Whether this result is a statistical artifact of our dataset, or a consequence of a mis-specified relationship is an open question. One way to check whether growth is indeed associated with lower inequality is to explore how growth affects the five quintiles of the income distribution separately. This should provide a more direct way of understanding changes in the income distribution than the aggregate measure of inequality given by the Gini coefficient. We already found that, on average, growth did not affect the share of income that accrues to the first quintile. For overall inequality to decrease while the poorest 20% of the population see their share of national income unaffected by growth, there should be redistribution taking place between the other quintiles of the income distribution.

Table 4: The Effect of Growth on Inequality

Dependant variable:	Level			Differences	
	Gini coefficient			First difference in Gini coefficient	
	OLS	GLS RE	IV	OLS	IV
Intercept	0.615 (0.052)	0.561 (0.056)	0.930 (0.381)		
Log(GDP) [*first diff.*]	**-0.028***** **(0.006)**	**-0.022***** **(0.006)**	**-0.065** **(0.031)**	**-0.072***** **(0.009)**	**-0.079**** **(0.041)**
P-value (H_0)	0.001	0.002	0.144	0.001	0.047
R-squared	0.08	0.08	0.07	0.19	0.22
# of obs.	303	303	281	299	277
# countries	87	87	87	87	87

Other control variables included in the level regressions are 6 regional dummies for Latin America, Sub-Saharan Africa, East-Asia and Pacific, Europe and Central-Asia, Middle-East and North-Africa and South-Asia.
OLS is an Ordinary Least Square estimate, pooling all of the country-year observations together.
GLS RE estimates are country random-effect panel estimates of the standard specification.
IV are 2SLS Instrumental Variable estimates, using the growth rate of real GDP over the past five years as instrument for Log(GDP). All variables are in per-capita terms
Standard errors are in parentheses. They are corrected for heteroskedasticity and for first-order autocorrelation in the difference equations, using the Newey-West procedure
*: the null hypothesis of a slope coefficient equal to zero can be rejected with 90% confidence. **: 95% confidence. ***: 99% confidence

3.5.3 Growth and the Different Parts of The Income Distribution

The Gini coefficient used in the previous section is an aggregate measure of the income distribution. It is a standardized measure of the area between the Lorenz curve and the 45-degree line that describes the Lorenz curve of a perfectly equal society. It does not say anything about the shape of the Lorenz curve, about the extent of poverty in a society, or the size of the middle class. In fact, changes in the Gini can reflect changes in the Lorenz curve that say nothing about inequality changes, in particular when the new and old Lorenz curve cross. It could also reflect redistributions of income of certain parts of the income distribution with other parts being unaffected. This could in fact explain the seemingly contradictory findings of the previous section. Growth could benefit relatively more lower classes than upper classes, without affecting the income shares of the poor. In this section, we use the data we have on the country-year Lorenz curves to understand quintile-specific changes of income in response to growth.

As described in section 3.3, more than 85% of our country-year observations include five points on the Lorenz curve. These points correspond to the shares of national income that accrues to each of the five quintiles. For the rest of the data where only Gini coefficients are available, we showed in section 3.3 how to construct the corresponding Lorenz curve, namely, the share of income accruing to the i-th quintile - s_i, can be inferred from the Gini coefficient, assuming that the distribution of income is log-normal:

$$s_i = \Phi \left[\frac{\Phi^{-1}(0.2i)}{\sqrt{2}\,\Phi^{-1}\left(\frac{1+G}{2}\right)} - 1 \right] - s_{i-1}$$

Where $s_0 = 0$, $i = 1...5$, G is the Gini coefficient expressed between 0 and 1, and $\Phi(.)$ is the cumulative distribution function of the standard normal distribution.

The corresponding average incomes in each quintile are obtained by multiplying the shares by 5 times the mean income. Table 5 on the next page shows the point estimates of five separate regressions of the average income in each quintile, on the logarithm of GDP per capita, still controlling for the six regional dummies. Column Q1 corresponds to column (III) in table 1. Columns Q2 to Q5 are the regression results for quintiles 2 to 5 respectively.

Table 5: Growth and average incomes by quintile

Equation (3.2)

<u>Dependant variable:</u>   Average income of each quintile

	Q1		Q2		Q3		Q4		Q5	
	<u>GLS</u>	<u>IV</u>	<u>GLS</u>	<u>IV</u>	<u>GLS</u>	<u>IV</u>	<u>GLS</u>	<u>IV</u>	<u>GLS</u>	<u>IV</u>
Intercept	-1.97 (0.19)	-0.82 (3.41)	-0.91 (0.20)	-0.93 (1.22)	-0.68 (0.14)	0.03 (0.82)	-0.15 (0.07)	0.26 (0.45)	-1.07 (0.11)	0.48 (0.84)
Log(GDP) check	1.06 (0.03)	0.96 (0.31)	1.06 (0.04)	1.05 (0.12)	1.11 (0.04)	1.08 (0.05)	1.09 (0.04)	1.09 (0.05)	0.96 (0.04)	0.92 (0.05)
R-squared	0.86	0.82	0.83	0.81	0.85	0.84	0.82	0.79	0.78	0.83
P-value(Ho)	0.057*	0.381	0.130	0.366	0.009***	0.111	0.32**	0.079*	0.242	?0.111
# of obs.	303	281	303	281	303	281	303	281	303	281
# countries	87	87	87	87	87	87	87	87	87	87

Other control variables included are 6 regional dummies for Latin America, Sub-Saharan Africa, East-Asia and Pacific, Europe and Central-Asia, Middle-East and North-Africa and South-Asia.
GLS RE estimates are country random-effect panel estimates of the standard specification.
IV are 2SLS Instrumental Variable estimates, using the growth rate of real GDP over the past five years as instrument for Log(GDP). All variables are in per-capita terms
Standard errors are in parentheses. They are corrected for heteroskedasticity.
*: the null hypothesis of a slope coefficient equal to one can be rejected with 90% confidence. **: 95% confidence. ***: 99% confidence
  Chi-squarred test of joint equality of coefficient estimates across quintiles : 11.14** (GLS) and 9.77** (IV)

Table 6: Growth and average incomes by quintile

Equation (3.4)

Dependant variable: First difference in average income of each quintile

	Q1		Q2		Q3		Q4		Q5	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Δ(Log(GDP)) check	1.002 (0.050)	0.972 (0.074)	1.072 (0.05)	1.041 (0.062)	1.117 (0.07)	1.121 (0.081)	1.108 (0.08)	1.117 (0.003)	0.842 (0.07)	0.861 (0.061)
R-squarred	0.399	0.371	0.325	0.320	0.103	0.056	0.164	0.071*	0.031**	0.030**
P-value(Ho')	0.10	0.11	0.10	0.09	0.12	0.11	0.09	0.11	0.10	0.12
# of obs.	299	299	299	299	299	299	299	299	299	299
# countries	87	87	87	87	87	87	87	87	87	87

Δ(Log(GDP)) is the first difference of log(GDP)

OLS is an Ordinary Least Square estimate, pooling all of the country-year observations together

IV are 2SLS Instrumental Variable estimates, using as instrument the growth rate of real GDP over the past five years prior to the year of the lagged value of Log(GDP). All variables are in per-capita terms

Standard errors are in parentheses. They are corrected for heteroskedasticity and for first-order autocorrelation using the Newey-West procedure

*: the null hypothesis of a slope coefficient equal to one can be rejected with 90% confidence. **: 95% confidence. ***: 99% confidence

Chi-squarred test of joint equality of coefficient estimates across quintiles : 11.14** (GLS) and 9.77** (IV)

First, a chi-squared test of joint equality of the five GLS estimates across the quintiles is significant at the 95% confidence level, and at the 90% level for the IV estimates; suggesting that growth affects the income distribution unevenly across quintiles. Moreover, while only a few of the point estimates are significantly different than one, we can notice a trend as we go up the quintiles on the income distribution. As before, the first quintile exhibits a one-for-one relationship between its average income and overall mean income. This is the case for the second quintile Q2 as well. However the point estimates for the third and fourth quintiles are higher than one. 1.11 for the GLS estimate in Q3 (significantly greater than one with 99% confidence) and 1.09 for Q4 (significantly greater than one with 95% confidence). When we use the 2SLS IV estimator the estimated standard errors are higher and the coefficients are slightly smaller: 0.96 for Q1 (p-value of equality to one, 0.381), 1.05 for Q2 (p-value 0.366), 1.08 for Q3 (p-value 0.111), 1.09 for Q4 (p-value 0.079) and 0.92 for Q5 (p-value 0.111). Only the elasticity of the average income in the fourth quintile is significantly higher than one (90% confidence). The IV estimator for Q5 is close of being significantly smaller than one with 90% confidence (p-value $= 0.111$).

This trend where growth seems to be benefiting the third and fourth quintiles more than average while it benefits the fifth quintile less than average, is even clearer when running the first-difference regressions (see table 6). As we discussed earlier, the 2SLS estimator exhibits higher precision in the differenced equations. The gain is that more point estimates can be assessed to be different than one with statistical confidence of at least 90%, as table 6 shows. Also, a chi-squared test of joint equality of the five estimates across the quintiles is significant at the 95% confidence level for both the GLS and IV sets of estimates.

In table 6, the IV point estimate of the elasticity of the top quintile average income with respect to overall mean income is 0.861 and is 95%-significantly smaller than 1 (p-value of null hypothesis of equality to one is 0.030). This elasticity is 1.211 and 1.117 for quintiles three and four respectively, both being significantly higher than 1 (p-values of 0.056 and 0.071 respectively[7]). On the other hand, the point estimates for the first and second quintiles are not significantly different than 1: 0.972 (p-value 0.371) and 1.041 (p-value of

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[7]All the p-values indicated when the dependant variable is the average income of a quintile correspond to the test of the null hypothesis that the coefficient is equal to one

0.320). This could be evidence that the incomes of the first two bottom quintiles in fact move one-for-one with overall mean income in the population, but that some redistributive dynamics takes place in the upper quintiles of the income distribution. The evidence in table 5 and especially table 6 point to such a dynamics where the 'middle classes' - defined as the incomes in the third and fourth quintiles - benefit more than the average of growth episodes, while the top quintile benefits less from growth than the average. This is consistent with our finding that growth actually reduces inequality.

To check the robustness of this finding, we will now turn to estimating the effect of growth on the *shares* of income accruing to each of the five quintiles. This should avoid the potential problem described earlier with having the dependant variable as the product of the income share and the explanatory variable (mean income). Tables 7 and 8 show the level and difference estimates for both the least squares and the 2SLS regressions. All regressions include the six regional dummies. Standard errors are corrected for heteroskedasticity and first-order serial correlation (in difference estimations) using the standard Newey-West procedure.

Even if not all estimators are statistically significant, both the level and difference OLS and 2SLS regressions confirm this trend where the share of income accruing to the top quintile seems to decrease with mean income, benefiting disproportionally more the third and fourth quintile compared to the two bottom quintiles which income shares are unaffected by growth. The null hypothesis of joint equality of the five estimates is rejected in both the GLS and IV level and difference regressions[8]. The 2SLS IV estimates of the elasticity of the income share with respect to (log of) GDP in the level regressions are: -0.0052 for Q1 (p-value 0.688), 0.0021 for Q2 (p-value 0.348), 0.0078 for Q3 (p-value 0.060), 0.0107 for Q4 (p-value 0.044), and -0.0112 for Q5 (p-value 0.07). These estimates show clearly that quintiles three and four see their share of income rise with GDP, while that share decreases for Q5. Even if slightly fewer coefficients are significant, the first-difference IV estimates are of same sign and magnitude, and confirm that trend: -0.0060 for Q1 (p-value 0.580), 0.0019 for Q2 (0.371), 0.0942 for Q3 (0.117), 0.0114 for Q4 (0.066), and -0.0104 for Q5 (0.089).

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[8]Chi-squared tests are reported at the bottom of both tables. All are significant at least at the 90% confidence level

Table 7: Growth and the shares of income by quintile

Equation (3.3)

<u>Dependant variable:</u> Share of income accruing to each quintile

	Q1		Q2		Q3		Q4		Q5	
	<u>GLS</u>	<u>IV</u>	<u>GLS</u>	<u>IV</u>	<u>GLS</u>	<u>IV</u>	<u>GLS</u>	<u>IV</u>	<u>GLS</u>	<u>IV</u>
Intercept	0.0027 (0.44)	0.0102 (0.71)	0.0041 (0.51)	0.0157 (0.68)	0.0008 (0.47)	0.0109 (0.72)	0.0121 (0.52)	0.0076 (0.69)	0.0047 (0.70)	0.0108 (0.71)
Log(GDP) check	-.0002 (.003)	-.0052 (.017)	.0065 (.003)	.0021 (.004)	.0113 (.004)	.0078 (.004)	.0117 (.004)	.0107 (.005)	-.0275 (.006)	-.0112 (.006)
R-squarred	.712	.688	.038**	.348	.007***	.060*	.006***	.040**	.000***	.07*
P-value(Ho)	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
# of obs.	303	281	303	281	303	281	303	281	303	281
# countries	87	87	87	87	87	87	87	87	87	87

Other control variables included are 6 regional dummies for Latin America, Sub-Saharan Africa, East-Asia and Pacific, Europe and Central-Asia, Middle-East and North-Africa and South-Asia.
GLS RE estimates are country random-effect panel estimates of the standard specification.
IV are 2SLS Instrumental Variable estimates, using the growth rate of real GDP over the past five years as instrument for Log(GDP). All variables are in per-capita terms
Standard errors are in parentheses. They are corrected for heteroskedasticity.
*: the null hypothesis of a slope coefficient equal to one can be rejected with 90% confidence. **: 95% confidence. ***: 99% confidence
Chi-squarred test of joint equality of coefficient estimates across quintiles : 11.14** (GLS) and 9.77** (IV)

Table 8: Growth and the shares of income by quintile

Equation (3.5)

Dependant variable: First difference in the share of income accruing to each quintile

	Q1		Q2		Q3		Q4		Q5	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Δ(Log(GDP)) check	-0.000 (.004)	-0.006 (0.10)	0.0015 (0.004)	0.0019 (0.005)	0.0097 (0.005)	0.0094 (0.006)	0.0109 (0.005)	0.0114 (0.006)	-0.0141 (0.006)	-0.0104 (0.006)
R-squared	0.593	0.580	0.372	0.371	0.061*	0.117	.037**	0.066*	0.025**	0.089*
P-value(Ho')	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
# of obs.	299	277	299	277	299	277	299	277	299	277
# countries	87	87	87	87	87	87	87	87	87	87

Δ(Log(GDP)) is the first difference of log(GDP)
OLS is an Ordinary Least Square estimate, pooling all of the country-year observations together
IV are 2SLS Instrumental Variable estimates, using as instrument the growth rate of real GDP over the past five years prior to the year of the lagged value of Log(GDP). All variables are in per-capita terms
Standard errors are in parentheses. They are corrected for heteroskedasticity and for first-order autocorrelation using the Newey-West procedure
*: the null hypothesis of a slope coefficient equal to one can be rejected with 90% confidence. **: 95% confidence. ***: 99% confidence
Chi-squarred test of joint equality of coefficient estimates across quintiles : 11.14** (GLS) and 9.77** (IV)

While more work would be needed to validate the robustness of these results (in particular using additional controls, better instruments etc.) - as they contradict the recent findings described in the introduction on no effect of growth on inequality - the estimates in tables 5 to 8 clearly show evidence that the benefits of growth are unevenly distributed among different quintiles. Growth could indeed reduce inequality by benefiting more the middle classes than the rest of the population. In the next section, we want to test a potential explanation of why this could be so, by looking at the cross-country evidence on redistribution and the income distribution.

3.6   Who Benefits from Redistribution ?

One mechanism that could potentially explain why growth might be benefiting disproportionally the middle-classes is through redistribution. It has long been argued that redistributive policies favor relatively more the middle classes in both developed and developing countries. Stiegler[1968] first documented this in the United States under the name of *Director's law*. One reason might be that social programs that target the poor are difficult and/or expensive to implement. Most of the transfers 'leak' to the middle classes. Also, indirect redistribution tools might be benefiting more the middle classes. Examples include secondary or higher education public spending and other traditional governmental functions. One can for example argue that fire and police activities serve relatively more often property-owners. Also income taxation, compared to the received social benefits, is higher for those who begin work early, compared with those who continue in school; those who die early, compared to those who live longer; those families where both spouses work, compared to those where only one spouse does; those families with more children etc. Finally, there could be political economy reasons that explain why the middle classes seem to be better able to direct redistribution to themselves rather than to the poor. One of these could be just that middle classes have more political weight. Politicians would then maximize their chance of being elected by running on political platforms close to the preferences of the middle class. Middle classes are generally more prone to participate in political decision-

making. They vote relatively more frequently than the poor. Also, in developing countries, the middle classes are generally employed in urban centers in the formal sector or the state sector; and have therefore more means of putting pressure on their governments to induce redistribution at their benefit. Whereas the poor are more often in rural areas where political contestation is weaker and harder to coordinate to voice their interests to their leaders.

Tables 9 and 10 of the next page summarize a series of regressions of the income and share of income in each quintile on the logarithm of GDP and three different proxies for redistribution; government consumption as a share of GDP, public expenditures in education as a share of GDP, and social spending as a share of GDP. As this is the most reliable estimate, we only show the results for the 2SLS IV estimations. The OLS and random effect estimates lead to very similar results, and the overall trend that we find across quintiles is unchanged. Table 9 shows the results of estimating the following regressions where the average income in each quintile are the dependant variables:

$$y^i_{c,t} = \alpha^i_{6,0} + \alpha^i_{6,1} y_{c,t} + \alpha^i_{6,2} \, GovCons_{c,t} + \alpha^{i'}_{6,3} \, Regions_c + \mu^6_c + \epsilon^6_{c,t} \qquad (3.6)$$

$$y^i_{c,t} = \alpha^i_{7,0} + \alpha^i_{7,1} y_{c,t} + \alpha^i_{7,2} \, EducExp_{c,t} + \alpha^{i'}_{7,3} \, Regions_c + \mu^7_c + \epsilon^7_{c,t} \qquad (3.7)$$

$$y^i_{c,t} = \alpha^i_{8,0} + \alpha^i_{8,1} y_{c,t} + \alpha^i_{8,2} \, SocSpending_{c,t} + \alpha^{i'}_{8,3} \, Regions_c + \mu^8_c + \epsilon^8_{c,t} \qquad (3.8)$$

Similarly we ran first-differenced versions of (3.6), (3.7) and (3.8):

$$\Delta y^i_{c,t} = \alpha^i_{6,1} \Delta y_{c,t} + \alpha^i_{6,2} GovCons_{c,t} + \Delta \epsilon^6_{c,t} \qquad (3.9)$$

$$\Delta y^i_{c,t} = \alpha^i_{7,1} \Delta y_{c,t} + \alpha^i_{7,2} \Delta EducExp_{c,t} + \Delta \epsilon^7_{c,t} \qquad (3.10)$$

$$\Delta y^i_{c,t} = \alpha^i_{8,1} \Delta y_{c,t} + \alpha^i_{8,2} \Delta SocSpending_{c,t} + \Delta \epsilon^8_{c,t} \qquad (3.11)$$

Where $\Delta y^i_{c,t} = y^i_{c,t} - y^i_{c,t-\delta(c,t)}$ (and similarly with the other variables) with $\delta(c,t)$ being the country-year specific time lag between country observations, which is at least five years.

Table 9: Redistribution and the incomes by quintile

Equation (3.6) to (3.8) – IV estimates

Dependant variable: Log of average income per quintile

Equation:	Q1 (3.6)	Q1 (3.7)	Q1 (3.8)	Q2 (3.6)	Q2 (3.7)	Q2 (3.8)	Q3 (3.6)	Q3 (3.7)	Q3 (3.8)	Q4 (3.6)	Q4 (3.7)	Q4 (3.8)	Q5 (3.6)	Q5 (3.7)	Q5 (3.8)	Chi^2
Log(GDP)	1.01 (.32)	0.94 (.32)	1.02 (.33)	1.02 (.32)	1.06 (.34)	1.11 (.29)	.94 (.29)	.97 (.32)	.96 (.31)	1.001 (.35)	1.121 (.31)	1.118 (.30)	1.011 (.30)	1.103 (.32)	1.120 (.33)	2.49
Gov-Cons	-.003 (.012)			.000 (.016)			.017 (.013)			.031** (.016)			-.042** (.022)			12.65**
Educ-Exp		.0002 (.0017)			.0002 (.0019)			.002 (.0017)			.0022 (.0016)			-.001 (.0017)		2.61
Soc-Spending			.0001 (.0007)			.0001 (.0006)			.0021*** (.0007)			.0013* (.0007)			-.002** (.0009)	9.27**
P-value (Ho)	0.361	0.344	0.612	0.317	0.367	0.542	0.121	0.184	0.012	0.021	0.152	0.087	0.041	0.147	0.029	
R-squarred	0.82	0.80	0.77	0.81	0.80	0.80	0.81	0.79	0.80	0.80	0.81	0.79	0.81	0.80	0.80	
# of obs.	171	163	157	171	163	157	171	163	157	171	163	157	171	163	157	
#countries	69	69	68	69	69	68	69	69	68	69	69	68	69	69	68	

Other control variables included are 6 regional dummies for Latin America, Sub-Saharan Africa, East-Asia and Pacific, Europe and Central-Asia, Middle-East and North-Africa and South-Asia.

IV are 2SLS Instrumental Variable estimates, using the growth rate of real GDP over the past five years as instrument for Log(GDP) and lagged values of Educ-Exp.

All variables are in per-capita terms

Standard errors are in parentheses. They are corrected for heteroskedasticity.

*: the null hypothesis of a slope coefficient equal to one can be rejected with 90% confidence. **: 95% confidence. ***: 99% confidence

The last column shows the chi-squared statistics of a test of joint equality of the coefficients over the five quintiles. Stars indicate the level of confidence that the null hypothesis of joint equality can be rejected.

Table 10: Redistribution and the shares of incomes by quintile

Equation (3.12) to (3.14) – IV estimates

<u>Dependant variable:</u> Log of average income per quintile

Equation:	Q1			Q2			Q3			Q4			Q5			Chi^2
	(3.12)	*(3.13)*	*(3.14)*	*(3.12)*	*(3.13)*	*(3.14)*	*(3.12)*	*(3.13)*	*(3.14)*	*(3.12)*	*(3.13)*	*(3.14)*	*(3.12)*	*(3.13)*	*(3.14)*	
Log(GDP)	0.001 (.002)	0.003 (.002)	0.002 (.003)	0.001 (.002)	0.000 (.002)	0.001 (.002)	0.004 (.001)	0.001 (.002)	0.005 (.002)	0.001 (.003)	-.000 (.002)	-.002 (.002)	-.001 (.032)	-.002 (.002)	0.0001 (.001)	1.21
Gov-Cons	.0002 (.001)			.0001 (.0013)			.0014 (.0011)			.0029** (.0012)			-.005*** (.0022)			22.14***
Educ-Exp		.0001 (.0014)			.0001 (.0011)			.0002 (.0017)			.0002 (.0012)			-.0004 (.0018)		2.75
Soc-Spending			.0001 (.0012)			.0001 (.0014)			.0019* (.0011)			.0023 (.0017)			-.0021** (.0011)	12.11**
P-value (Ho)	0.631	0.741	0.426	0.782	0.784	0.731	0.119	0.629	0.078	0.037	0.122	0.109	0.009	0.348	0.034	
R-squarred	0.79	0.81	0.80	0.80	0.79	0.81	0.80	0.81	0.80	0.78	0.82	0.80	0.81	0.79	0.80	
# of obs.	171	163	157	171	163	157	171	163	157	171	163	157	171	163	157	
#countries	69	69	68	69	69	68	69	69	68	69	69	68	69	69	68	

Other control variables included are 6 regional dummies for Latin America, Sub-Saharan Africa, East-Asia and Pacific, Europe and Central-Asia, Middle-East and North-Africa and South-Asia.
IV are 2SLS Instrumental Variable estimates, using the growth rate of real GDP over the past five years as instrument for Log(GDP) and lagged values of Educ-Exp. All variables are in per-capita terms
Standard errors are in parentheses. They are corrected for heteroskedasticity.
*: the null hypothesis of a slope coefficient equal to one can be rejected with 90% confidence. **: 95% confidence. ***: 99% confidence
The last column shows the chi-squared statistics of a test of joint equality of the coefficients over the five quintiles. Stars indicate the level of confidence that the null hypothesis of joint equality can be rejected.

In addition to the measures of redistribution, and the logarithm of GDP, we control in tables 9 and 10 for the same six regional dummies in the level regressions. Instrumental variables include the average growth of income over the past five years and lagged values of government consumption, educational public expenditures and social expenditures.

In table 10, the dependant variables are the shares of income accruing to each quintile. The table shows the estimates of the following level and first difference specifications:

$$s_{c,t}^i = \beta_{4,0}^i + \beta_{4,1}^i y_{c,t} + \beta_{4,2}^i \, GovCons_{c,t} + \beta_{4,3}^{i'} \, Regions_c + \theta_c^4 + \nu_{c,t}^4 \qquad (3.12)$$

$$s_{c,t}^i = \beta_{5,0}^i + \beta_{5,1}^i y_{c,t} + \beta_{5,2}^i \, EducExp_{c,t} + \beta_{5,3}^{i'} \, Regions_c + \theta_c^5 + \nu_{c,t}^5 \qquad (3.13)$$

$$s_{c,t}^i = \beta_{6,0}^i + \beta_{6,1}^i y_{c,t} + \beta_{6,2}^i \, SocSpending_{c,t} + \beta_{6,3}^{i'} \, Regions_c + \theta_c^6 + \nu_{c,t}^6 \qquad (3.14)$$

As well as their first differenced versions:

$$\Delta s_{c,t}^i = \beta_{4,1}^i \Delta y_{c,t} + \beta_{4,2}^i \Delta GovCons_{c,t} + \Delta \nu_{c,t}^4 \qquad (3.15)$$

$$\Delta s_{c,t}^i = \beta_{5,1}^i \Delta y_{c,t} + \beta_{5,2}^i \Delta EducExp_{c,t} + \Delta \nu_{c,t}^5 \qquad (3.16)$$

$$\Delta s_{c,t}^i = \beta_{6,1}^i \Delta y_{c,t} + \beta_{6,2}^i \Delta SocSpending_{c,t} + \Delta \nu_{c,t}^6 \qquad (3.17)$$

Where $\Delta s_{c,t}^i = s_{c,t}^i - s_{c,t-\delta(c,t)}^i$ (and similarly with the other variables) with $\delta(c,t)$ being the country-year specific time lag between country observations, which is at least five years.

Both tables clearly point towards the same trend: average incomes of the middle classes (quintiles 3 and 4), and the shares of incomes accruing to them are *increasing* with re-

distribution as measured both by government consumption and social spending. On the other hand, expenditures on education, as a percentage of GDP, do not seem to favor any particular group of income.

The last columns in both tables show the results of chi-squared tests of joint equality of the elasticity estimates across quintiles. The chi-squarred value for the Government Consumption equation (3.6) is 12.65 which means that the null of joint equality can be rejected at the 95% level of confidence. It is rejected at the same level for Social Expenditures (chi-squarred is 9.27), while we cannot reject the null of joint equality for Expenditures in Education in equations (3.7) (chi-squarred is 2.61). The corresponding values in table 10 for equations (3.12), (3.13), and (3.14) are respectively, 22.14(null 99%-rejected), 2.75 (null cannot be rejected), and 12.11 (null 95%-rejected).

Moreover, while not all coefficient estimates show statistical significance, the signs and magnitudes are all consistent with the trend identified above. Whether using levels or differences, ordinary least squares, country random effect GLS or 2SLS instrumental variables[9], the shares of income accruing to the first and second quintiles seem unaffected by redistribution, the share of income of the top quintile is *reduced* by redistribution, and the share of income accruing to the middle classes *increases* with redistribution. Again, this only holds for redistribution when it is proxied with Government Consumption or Social Expenditures. Education Expenditures have an even effect[10] on the income distribution in both tables 9 and 10.

Interestingly, except for a few exceptions, the point estimates of the coefficient on the logarithm of mean income are not significantly different than one, whether in the level or difference estimations. This is true for all quintiles. A chi-squared test cannot reject the null of joint equality to one of all five coefficients. Similarly, the coefficients on $log(GDP)$ are not significantly different than zero in all quintiles of table 10 where the dependent variables are the shares of income accruing to each quintile. This suggests that the uneven distribution of growth identified in section 3.5 could indeed be due to redistribution schemes

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[9]For clarity, only the IV estimates are presented in tables 9 and 10

[10]Or may be no effect at all as the growth literature also finds

that are disproportionally benefiting the third and fourth quintiles.

Finally, one should interpret these results with caution. First, the income distribution panel is very unbalanced and within-country observations are irregularly spaced. Second, it is not clear whether the income distribution survey data really capture the impacts of redistribution mechanisms other than direct social transfers. Finally the redistribution measures are likely to be jointly determined with the income distribution. Choices of redistribution are made by societies based on the preferences of economic agents and their relative weight in the political decision-making process. With no good instrument for redistribution, it is likely that our estimates are biased. It is not clear however, why the bias sign and magnitude should consistently be different for the third and fourth quintiles, compared to the first, second and fifth quintile.

3.7 Conclusion

The contributions of this chapter are threefold:

First, we confirm the findings of Dollar-Kraay[2001] and Gallup-Radelet-Warner[1998] that the poor[11] benefit from growth no less than the average income in the population. Their share of total income is unaffected by growth. We confirmed the previous studies by including additional sub-Saharan countries in the dataset, and also by using the income share of the first quintile in addition to their mean income as dependant variables.

The second set of results deals with the effect of growth on the other parts of the income distribution. Contradicting recent evidence, we find that economic growth seems to *reduce* inequality as measured by the Gini coefficient. On average, a one percent increase of GDP reduces the Gini coefficient by 0.022 percentage points. We will not overemphasize this finding as it is not the primary purpose of this research. Rather, we want to look

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[11]Defined as those with incomes in the two bottom quintiles of the income distribution

at the effect of growth on the *shape* of the Lorenz curve in a country instead of focusing on the area it forms with the 45-degree line. But in fact, looking at each income quintile separately, we find a pattern where growth seems to unambiguously reduce inequality: the mean income for the first and second quintile grow one-for-one with the overall GDP, the third and fourth quintile grow *more than* proportionally than GDP and the top quintile grows *less than* proportionally than GDP. Alternatively, the *share* of income earned by the bottom 40% of the population remains unchanged in the growth process while the income shares of the third and fourth quintiles *increase*, and the one of the fifth quintile *decreases*. All these effects are jointly significant; most estimates are statistically significant at least at the 90% confidence level; and they seem to be robust to different specifications.

Finally, we provide evidence that could explain this uneven distribution of the benefits of growth in favor of the middle classes. Using three proxies for redistribution (government consumption, expenditures in education, and social transfers; all as a percentage of GDP), we find that more redistribution does not affect the income shares of the bottom 40% of the population, it *increases* the income share of the middle 40% of the population, and it *reduces* the income share of the top income quintile. This evidence supports political economy theories of the median-voter type that argue that the middle classes are generally able to direct redistribution in their favor. This preliminary result should more be considered as a starting point to better understand how different redistributive mechanisms affect various parts of the income distribution. Future work should focus in particular on constructing better measures of redistribution than the ones we used.

3.8 Annex

List of Countries in the Dollar-Kraay Data Set

Number	Code	Name	Period (Begin-End)
1.	AUS	Australia	1969-1993
2.	BEL	Belgium	1979-1992
3.	BGD	Bangladesh	1973-1996
4.	BGR	Bulgaria	1989-1995
5.	BHS	Bahamas	1970-1991
6.	BRA	Brazil	1960-1995
7.	CAN	Canada	1960-1994
8.	CHE	Switzerland	1982-1992
9.	CHL	Chile	1968-1994
10.	CHN	China	1980-1995
12.	COL	Columbia	1978-1995
13.	CRI	Costa Rica	1961-1996
14.	DEU	Germany	1963-1994
15.	DNK	Denmark	1976-1992
16.	DOM	Dominican Republic	1976-1996
17.	DZA	Algeria	1998-1995
18.	EGY	Egypt, Arab Republic	1960-1991
19.	ESP	Spain	1965-1990
20.	EST	Estonia	1988-1993
27.	GUY	Guyana	1960-1993
28.	HKG	Hong-Kong	1971-1991
29.	HND	Honduras	1968-1996
30.	HUN	Hungary	1967-1993
31.	IDN	Indonesia	1970-1993

Number	Code	Name	Period (Begin-End)
32.	IND	India	1960-1994
33.	IRL	Ireland	1973-1987
34.	IRN	Iran, Islamic Republic	1969-1984
35.	ITA	Italy	1974-1995
36.	JAM	Jamaica	1960-1993
37.	JOR	Jordan	1980-1996
38.	JPN	Japan	1962-1994
39.	KOR	Korea, Republic	1961-1993
40.	LKA	Sri Lanka	1963-1995
41.	LUX	Luxembourg	1985-1991
42.	LVA	Latvia	1988-1993
43.	MAR	Morocco	1984-1991
44.	MDA	Moldova	1988-1993
45.	MEX	Mexico	1960-1995
47.	MUS	Mauritius	1980-1991
48.	MYS	Malaysia	1970-1995
49.	NGA	Nigeria	1986-1996
50.	NLD	Netherland	1975-1991
51.	NOR	Norway	1962-1991
52.	NPL	Nepal	1984-1996
53.	NZL	New Zealand	1973-1989
54.	PAK	Pakistan	1969-1996
55.	PER	Peru	1971-1994
56.	PHL	Philippines	1960-1996
57.	POL	Poland	1976-1993
58.	PRI	Puerto Rico	1969-1989
59.	PRT	Portugal	1973-1995
60.	ROM	Romania	1989-1994
61.	SGP	Singapore	1973-1988

Number	Code	Name	Period (Begin-End)
63.	SLV	El Salvador	1977-1995
64.	SWE	Sweden	1967-1990
65.	SYC	Seychelles	1978-1984
66.	THA	Thailand	1962-1992
67.	TTO	Trinidad a Tobago	1960-1992
68.	TUN	Tunisia	1965-1990
69.	TUR	Turkey	1968-1994
70.	TWN	Taiwan	1964-1990
71.	TZA	Tanzania	1969-1993
72.	USA	United St. of America	1960-1994
73.	VEN	Venezuela	1971-1995

List of Additional Sub-Saharan Countries (not included in D-K)

Number	Code	Name	Period (Begin-End)
1.	BWA	Botswana	1970-1988
2.	CIV	Cote d' Ivoire	1960-1996
3.	GAB	Gabon	1960-1980
4.	GHA	Ghana	1987-1996
5.	KEN	Kenya	1960-1992
6.	MDG	Madagascar	1960-1993
7.	MWI	Malawi	1968-1993
8.	MUS	Mauritius	1979-1991
9.	NGA	Nigeria	1960-1993
10.	SEN	Senegal	1960-1991
11.	TZA	Tanzania	1963-1993
12.	UGA	Uganda	1970-1994
13.	ZMB	Zambia	1960-1996

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