Education, Corruption, and the Distribution of Income[*]

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Abstract: We model the two way interaction between education, corruption and the level of output. Corruption reduces income levels and hence educational attainment. Education in turn affects the incentives for corruption: more education increases output and thus the rents from corruption, but it also increases the probability that the electorate identifies corrupt behavior and ousts the incumbent party. In this context, we identify the conditions under which an opportunist party has the incentives to take actions that will allow the economy to escape from a poverty trap. Our analysis shows that the relationship between education, output levels and the level of corruption is non-monotonic, and that both institution-led development and education-led development are possible. Which path occurs crucially depends on the initial level of inequality.

Key words: Inequality, corruption, education, economic development.

JEL Classification: O1

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1. Introduction

It is well established that education is associated with greater electoral participation,[1] and a number of authors have studied the implications that the relationship between education and participation has for economic development; see, for example, Bourguignon and Verdier (2000). What has received less attention is the fact that education also affects individuals' capacity to assess policies and parties' behavior. In this paper we examine the idea that, in a democracy, a more educated electorate has a greater capacity to identify corrupt parties and hence can reduce rent-extraction by the political class. This generates two-way relationships between corruption and education that can help us understand some of the empirical puzzles concerning education, institutional quality, and development.

There exists substantial empirical evidence that education improves "political knowledge." Survey data document that more educated individuals better identify the quality of political institutions, parties, and implemented policies, and that education improves individuals' abilities to comprehend political events and form consistent political views (see Galston, 2001, Delli Carpini and Keeter, 1996, and Nie et al., 1996). Individuals with lower levels of political knowledge have been shown to be more likely to rely on character impressions rather than policy evaluation in their voting behavior (Popkin and Dimock, 1999, see Galston, 2001, for a survey). More educated individuals are also more likely to take civic engagements, such as writing letters to newspapers or contacting public officials (Glaeser, Ponzetto, and Shleifer, 2007).

Recent work has highlighted the role of information and education in reducing corruption. Reinikka and Svensson (2005) find that, in Uganda, a newspaper campaign informing parents and schools of the funds provided by the government for education substantially reduced the fraction of the funds captured by local politicians and increased true spending in educational infrastructure. This indicates the potential role of information in preventing corruption. Glaeser and Saks (2006) argue that education tends to increase convictions for corruption, and find support for this argument using historical data for US states.

Our analysis is based on two crucial mechanisms relating education with the behaviour of the party in government. On the one hand, an honest party sets lower tax

[1] See for example U.S. Department of Education, (2003).

rates than a corrupt one, which increases the net income of the population and allows more individuals to afford education. On the other hand, more educated individuals have two opposing effects on the party's payoff from corruption. More education increases output and hence potential corruption rents, but it also lowers the reelection probability of a corrupt incumbent since educated voters are more likely to identify corrupt parties. As a result the expected payoff from corruption is non-monotonic in the average level of education.

The strategic behavior of parties is the key element in our analysis. We find that under certain circumstances, opportunistic parties may behave honestly, or even pass what we term *constitutional reform*, which improves transparency and prevents future corruption, thus bringing the economy out of a poverty trap. Which strategy dominates crucially depends on two things: the level of education and the degree of wealth inequality. Education is crucial as it determines both the current level of rents and the probability of being identified as corrupt. The degree of inequality, in turn, determines the number of individuals that can become educated and hence future rents.

We find that it is countries with intermediate levels of education that are most likely to be stuck in a poverty trap. The strategic decisions of opportunistic parties lead to corruption for intermediate levels of education, and to honest behavior for high and low levels of human capital, implying that at the aggregate level the relationship between education, corruption and output is non-monotonic.

Our analysis shows that there are two ways in which an economy can get out of a poverty trap. Economic development can be led either by political reform which results in low taxation and then generates education expansion, or by an initial accumulation of human capital that eventually forces parties to behave honestly. This multiplicity of development paths can help us understand why the empirical literature has had so much difficulty in identifying whether it is good institutions that "cause" education, or whether education leads to good institutions; see Acemoglu, Johnson and Robinson (2001, 2002) and Glaeser et al. (2004). We explore the circumstances under which one or the other path to development is likely to take place, and find that initial wealth inequality plays a crucial role in determining which of them is followed. Our results are in line with the evidence provided by Easterly (2005), who after carefully instrumenting for inequality, finds that an unequal distribution is a major impediment to prosperity, good institutions, and high educational achievement.

The paper adds to the growing literature on endogenous political participation. Existing models have examined the implications when electoral participation depends on the level of education and they have also considered systems in which agents vote directly on the extent of redistribution. Closest to our analysis are Acemoglu and Robinson (2000) and Bourguignon and Verdier (2000). The political elite in Bourguignon and Verdier face a similar trade-off as the party in our model: increased education leads to higher income for the elite (due to a technological externality) but also to increased electoral participation, and hence more redistribution. However, their model generates a monotonic relationship between initial income, education, and the extent of democratization, which has proven difficult to confirm empirically. Our analysis shares with Acemoglu and Robinson (2000) the idea that those in government may be interested in committing to institutional changes which limit their power in order to maximize their long-term well being. For Acemoglu and Robinson it is the threat of revolution that forces parties to extend franchise and commit to redistribution in the future; in our setup it is the threat of not being reelected that can lead to the introduction of constitutional reform.

Other recent papers have emphasized the endogeneity of institutions; see Aghion, Alesina, and Trebbi (2004), Cervellati, Sunde and Fortunato (2006), and Galor, Moav and Vollrath (2006). Glaeser, Ponzetto, and Shleifer (2007) examine the crucial role of education in bringing about democracy. The key aspect of their analysis is that education increases social involvement and hence results in greater active support for democracy. In our setup, social involvement takes the form of better monitoring of politicians within a democracy, and this has important implications for aggregate behaviour.

Our work is also related to the recent literature on corruption. One strand of the literature has tried to understand the incentives for corruption and rent-seeking in a static context.[2] Another strand has examined the impact of corruption on growth, following the seminal work of Mauro (1995, 1997) who finds empirical support for the idea that more corruption reduces growth. Only a limited number of papers have developed dynamic models of growth and corruption; see Mohtadu and Ror (2003) and Blackburn et al. (2002). In particular, the relationship between education and corruption has received little attention. Two notable exceptions are Ehrlich and Lui

[2] This literature started with Krueger (1974). For recent work on the determinants of corruption see Shleifer and Vishny (1993), Bliss and Di Tella (1997), Ades and Di Tella (1999), or Emerson (2006).

(1999) and De La Croix and Delavallade (2006). Ehrlich and Lui have examined the effect of corruption on growth when agents choose how to divide their time between the accumulation of human capital and rent-seeking activities. However, their focus is on the diversion of resources into rent-seeking. De la Croix and Delavallade explore the idea that endogenous corruption affects the type of public expenditure, diverting resources from growth-enhancing human capital accumulation to other types of expenditures.

The paper is organized as follows. Section 2 describes the production sector and education decisions, using the overlapping-generations model with imperfect capital markets developed by Galor and Zeira (1993). It shows how the tax rate affects bequests and the level of human capital, and highlights the role played by initial inequality. Section 3 introduces the political structure of the model, in which a self-interested party chooses the tax rate. Section 4 examines the strategic behavior of the party as a function of initial education and wealth inequality. We then examine the dynamics of education, and characterize the possible development paths. Section 5 concludes.

2. Production, Education and Taxation

2.1. Description of the Economy

The production and education structures follow Galor and Zeira (1993),[3] to which we add a proportional income tax that is levied in order to finance a public good.

2.1.1 Production

Consider a small, open economy with skilled and unskilled labour, denoted L_{St} and L_{Ut}, respectively. Skilled and unskilled workers produce output in separate, competitive sectors denoted by *j*, with $j = u, s$. The production functions are given by,

$$Y_{jt} = K_{jt}^{\alpha}\left(A_j L_{jt}\right)^{1-\alpha}, \qquad 0 < \alpha < 1 \tag{1a}$$

where K and A represent physical capital and technology, respectively. We assume $A_s > A_u$, implying that technology used by skilled workers is more productive.

[3] We refer the reader to the original paper for a detailed discussion and motivation of the assumptions. See also Galor and Moav (2004, 2006) for work on the long-run relationship between inequality, education and income levels.

Firms can borrow at the constant world interest rate, *r*. All income is taxed at rate τ_t, where the tax rate is determined endogenously in the political process as will be specified in section 3. Equality between the world interest rate and the domestic after-tax return on capital determines the amount of capital employed in each sector. The capital-labor ratios are given by $k_{jt} = A_j\left(\alpha(1-\tau_t)/r\right)^{1/(1-\alpha)}$, where $k_{jt} \equiv K_{jt}/L_{jt}$. As a result, wages, w_{jt}, are independent of the supplies of the two types of workers, with

$$w_{jt} = \lambda_j (1-\tau_t)^{\alpha/(1-\alpha)}, \tag{2}$$

where $\lambda_j = (1-\alpha)A_j(\alpha/r)^{\alpha/(1-\alpha)}$. Note that the wage depends negatively on the tax rate, through the effect that the latter has on the capital stock. Using the labor market clearing constraint, $L_{Ut} + L_{St} = 1$, aggregate output can be expressed as

$$Y_t \equiv Y_{ut} + Y_{st} = (1-\tau_t)^{\alpha/(1-\alpha)} \frac{\lambda_u (1-L_{St}) + \lambda_s L_{St}}{1-\alpha} \tag{1b}$$

Higher taxes depress output while an increase in the fraction of the labor force that is educated raises output.

We assume that production requires the provision of a public good, which can be thought of as an infrastructure requirement. We follow García-Peñalosa and Turnovsky (2005), and assume that ϕY_t units of the public good are required to produce a level of output Y_t, with $0 < \phi < 1$. The public good has a constant unit costs, *c*, implying that the total cost of the public good is $c\phi Y_t$.

2.1.2 Education, Consumption and Bequests

There is a mass 1 of overlapping-generations dynasties indexed by *i*. Agents live for two periods, implying that the population measure is 2. Agents differ in their initial wealth, with all the skilled workers holding wealth $x_{s,0}$ and all the unskilled $x_{u,0} < x_{s,0}$ at time 0. The timing is as follows: at the beginning of her first period of life an individual receives a bequest from her parent and decides whether or not to invest in education. Education takes no time. She then works for that period as either skilled or unskilled, and has an offspring at the end of the period. In the second period, she does not work, consumes and leaves a bequest to her child. There are elections at the beginning of each period, and all agents vote in them.

Each worker derives utility from her own consumption, c_i, and the bequest left to her offspring, b_i, with the utility function taking the form

$$U_{it} = \left(\frac{c_{it}}{1-\beta}\right)^{1-\beta}\left(\frac{b_{it}}{\beta}\right)^{\beta}, \qquad \text{where} \quad \beta < 1. \tag{3}$$

Utility optimization implies that consumption and bequests are constant fractions of per capita output, $c_{it} = (1-\beta)y_{it}$ and $b_{i,t} = \beta y_{i,t} = x_{i,t+1}$, where $x_{i,t+1}$ is the inheritance that a young individual from dynasty *i* receives from her parents, i.e. her wealth. Substituting for consumption and the bequest, the indirect utility function is given by

$$U_i = y_i. \tag{3'}$$

We assume there is a fixed education cost, *e*, and that borrowing to finance education is not possible.[4] The incomes of an unskilled and a skilled agent are then

$$y_{u,t} = (1+r)\left[(1-\tau_t)w_u(\tau_t) + x_t\right], \tag{4a}$$

$$y_{s,t} = (1+r)\left[(1-\tau_t)w_s(\tau_t) + \left(x_t - e\right)\right]. \tag{4b}$$

After receiving their bequest, young agents decide whether or not to study. A necessary condition for investment in education is then that their bequest is large enough to cover the cost of education, i.e. $x_{it} \geq e$. Wealthy agents then invest in education if the lifetime income of being skilled is higher than that of being unskilled, that is, if $y_s > y_u$. This inequality reduces to the condition that the return to education is greater than the interest an agent could obtain from investing *e* in physical capital, that is,

$$(1-\tau_t)\left[w_s(\tau_t) - w_u(\tau_t)\right] = (1-\tau_t)^{1/(1-\alpha)}(\lambda_s - \lambda_u) \geq e.$$

Note that this equation is independent of the agents' wealth, implying that if it is satisfied, all agents wish to become educated. Furthermore, this equation implies that a low enough tax rate $\tau_t < \hat{\tau}$ is required for agents to want to study, where $\hat{\tau} \equiv 1 - \left[e/(\lambda_s - \lambda_u(\tau_t)\right]^{1-\alpha}$.

2.1.3 Dynamics

The dynamics of the model are given by the evolution of bequests; they are characterized by the two difference equations:

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[4] None of our results would change in the more general case in which borrowing to invest in education is possible but costly due to imperfect capital markets, as in Galor and Zeira (1993).

$$x_{u,t+1} = \beta(1+r)\left(\lambda_u(1-\tau_t)^{1/(1-\alpha)} + x_{u,t}\right), \tag{5a}$$

$$x_{s,t+1} = \beta(1+r)\left(\lambda_s(1-\tau_t)^{1/(1-\alpha)} + x_{s,t} - e\right) \tag{5b}$$

The bequests of all dynasties with wealth $x_t < e$ are governed by equation (5a), while those of dynasties with bequests $x_t \geq e$ are governed by (5b). These two functions are depicted in Figure 1, where the lower line represents the bequest function of the unskilled and the higher one the bequest function of the skilled. Under the assumption of a constant tax rate and $(1+r)\beta < 1$ (which occurs if the propensity to bequeath is not too large), these two functions intersect the 45° degree line and converge to the steady states $x_{u,t+1} = x_{u,t} = \bar{x}_u$ and $x_{s,t+1} = x_{s,t} = \bar{x}_s$.

Figure 1 about here

Assuming a constant tax rate, the long-run distribution of wealth converges to an invariant distribution which is a function of the initial distribution; see Galor and Zeira (1993). The long-run levels of wealth held by the unskilled and by the skilled are, respectively,

$$\bar{x}_u[\tau] = \frac{\beta(1+r)}{1-(1+r)\beta}\lambda_u(1-\tau)^{1/(1-\alpha)}, \tag{6a}$$

$$\bar{x}_s[\tau] = \frac{\beta(1+r)}{1-(1+r)\beta}\left(\lambda_s(1-\tau)^{1/(1-\alpha)} - e\right), \tag{6b}$$

while the steady state fraction of skilled (unskilled) workers is given by the proportion of dynasties whose initial wealth exceeds (falls below) the cost of education.

Galor and Zeira discuss the equilibrium at length. They examine the role of the production function (technology and interest rate), and the initial distribution of wealth in determining the feasible equilibria. Here, we are interested in the political economy of taxation and hence investigate the impact of the tax rate on the education decision.

An equilibrium with inequality requires a tax such that rich dynasties can afford education, while poor dynasties cannot, i.e. $\bar{x}_s(\tau) \geq e$ and $\bar{x}_u(\tau) < e$. From (6) this implies a tax in the interval $[\bar{\tau}_u, \hat{\tau}]$, where $\bar{\tau}_u = 1-(e(1-\beta(1+r))/\beta(1+r)\lambda_u)^{1-\alpha}$. Any tax rate lower than $\bar{\tau}_u$ allows a descendent of those currently unskilled to

eventually study, while any tax greater than $\hat{\tau}$ implies that even the children of the skilled are not able to afford education in the long-run.

In what follows we suppose

Assumption 1: The initial tax rate τ_0 *and initial distribution of wealth are such that the initial equilibrium exhibits inequality. That is,* $\tau_0 \in (\bar{\tau}_u, \hat{\tau})$ *and* $x_{u,0} < e < x_{s,0}$.

We make assumption 1 in order to focus on the interesting case of an initially unequal society. The analysis of how political corruption and reform affect educational attainment would be irrelevant if all workers could afford education from time *t*=0.

2.2. Dynamic Effects of Taxation

We can now analyze the impact of tax changes on income and bequests, and hence on the distribution of income and educational attainment. Lower taxes have a direct and an indirect effect on individual incomes: for a given wage, lower taxes increase disposable income; they also increase the net return to capital, leading to a capital inflow that raises all wages. These two effects shift upwards the bequest functions, implying a higher bequest at $t+1$ for any given bequest at *t*, as depicted in figure 1.

The impact on education depends on whether the tax level is higher or lower than the threshold $\bar{\tau}_u$. Any tax rate $\tau > \bar{\tau}_u$ generates an equilibrium with inequality represented by $(\bar{x}_u, \bar{x}_s)$. The reduction of the tax to a level below $\bar{\tau}_u$ would shift the bequest function sufficiently for the fixed point of the unskilled bequest function to disappear, as depicted in Figure 2. Consequently, all dynasties end up being skilled in the long-run with a bequest level of $\bar{x}_s'$. This equilibrium results in higher output and complete equality.

These changes may, however, take time depending on the initial level of inequality. Figure 2 depicts the dynamic adjustment of the economy in response to a reduction in the tax rate from τ_0 to $\tau^1 < \bar{\tau}_u$. The tax reduction shifts up the bequest schedule, which increases the wealth of the next generation. If the initial wealth level of the unskilled at *t* is low, for example x_0, their offspring will receive an inheritance of x_1 which is less than the cost of education. They will hence be unable to study and

the skilled labor supply at *t*+1 will be equal to that at *t*. Some descendent of this dynasty will eventually be able to study, but it will take time. Now suppose that the initial level of wealth of the unskilled is high, at $\bar{x}_u$. In this circumstance they will leave a bequest to their offspring will be $x_1' > e$, implying that all those born at *t*+1 will be able to afford education and the skilled labor force at *t*+1 will be equal to 1.

Figure 2 about here

In our two-class economy, we can define the degree of inequality as the distance between the initial wealth of the educated and that of the non-educated, $x_{s,0} - x_{u,0}$. For a given level of average wealth in the economy, and given the skilled and unskilled populations, a lower value of $x_{u,0}$ implies greater inequality. Then, the degree of inequality determines how many periods of low taxes are needed for the poor to be able to afford education. We denote the number of periods needed by *N*. From figure 3, it is clear that the lower $x_{u,0}$ (i.e. the greater inequality is), the larger *N* will be.[5] We can summarize the results on the effect of tax changes on education as follows:

Proposition 1: Dynamic Effects of Tax Cuts

A reduction in the tax rate from τ_0 *to* $\tau^1 < \bar{\tau}_u$ *leads to a fully educated labor force,* $L_S = 1$*, and to an equal distribution of wealth. The higher the degree of initial wealth inequality, measured by* $x_{s,0} - x_{u,0}$*, the greater the number of periods N that it will take to achieve education expansion.*

Having established the relationship between the education and the distribution of wealth in response to a change in taxes, we can now turn to examine how the level of education and inequality affect corruption.

[5] Note, however, that since $x_{u,0}$ is continuous and *N* discreet, the function $N(x_{u,0})$ will be a step function.

3. Political Economy

3.1. Political Rents

There are many potential parties, all of which are infinitely lived. A single party is elected each period in order to provide a public good. There are two sources of political rents. On the one hand, there is an ego rent derived from being in power at period *t*, denoted *u*; on the other, there may be monetary rents, denoted π_t, which the party receives if it behaves corruptly at *t*.

We suppose that the cost of the public good $c\phi Y_t$ is not known to the electorate, and this is what creates the possibility for corruption, defined as the pocketing of part of the tax revenue by the party. Since tax revenue is given by τY_t, the tax rate necessary to finance the public good is $\tau^c = c\phi$. We will term this the "competitive tax rate". The party could, however, claim that the cost of provision is greater than it actually is, and set a higher tax rate, $\tau \geq \tau^c$. The difference between tax revenues and expenditure in the public good then generates monetary rents that will be pocketed by the party in power. Monetary rents are given by

$$\pi_t = (\tau_t - c\phi)Y_t, \tag{7}$$

and, for given aggregate income, are increasing in the tax rate. However, as we saw in section 2, a higher tax rate reduces the capital-labor ratio and hence aggregate output. These two opposing forces imply that rents are a concave function of τ, hence the party will choose the tax rate that maximizes rents from corruption. Using (1b) to substitute for Y_t, we obtain the tax rate that maximizes rents,

$$\tau^* = 1 - \alpha(1 - c\phi), \tag{8}$$

and the rent obtained by a corrupt party at time *t*, namely

$$\pi_t = a\left(1 + \varphi L_{St}\right), \tag{9}$$

where $a = A_u(1-\alpha)^2\left(\alpha^2/r\right)^{\alpha/(1-\alpha)}(1-c\phi)^{1/(1-\alpha)}$, and $\varphi = A_s / A_u - 1$. Clearly, a higher level of education results in a larger rent, as this increases the tax base. Rents also increase in the level of unskilled productivity, A_u, and the skill premium, A_s / A_u, and decrease in the world interest rate, *r*, and the cost of providing the public good, *c*.

The analysis of corrupt regimes would be irrelevant if corrupt taxes were associated with equality, either because they allow all agents or none to study. Hence

we introduce Assumption 2 to ensure that political reform can have an impact on the level of education:

Assumption 2: The competitive tax rate satisfies $\tau^c < \bar{\tau}_u$, *while the corrupt tax rate* τ^* *lies in the range* $(\bar{\tau}_u, \hat{\tau})$.

This assumption is satisfied for an intermediate range of the cost of providing the public good. If the cost is too high, even the competitive tax rate will be too large for the wealthiest individuals to study; if the cost is too low, all dynasties will be able to afford education even when τ^* is imposed. Assumption 2 then implies that when the corrupt tax rate τ^* is chosen the level of education is unchanged, while under the competitive tax rate τ^c all dynasties can eventually study.

3.2. The Political Process

At the beginning of each period an election takes place to elect the party in power for a term that lasts one period. The party may be reelected, and the probability of election depends on the party's actions and the level of education in the economy, as will be specified below.

The party in power can undertake two actions. First, it announces the cost of the public good and sets the tax rate for that period. It can set a competitive tax, τ^c, in which case we say it is "honest", or claim that the cost of the public good exceeds *c*, charge $\tau^* > \tau^c$, and pocket the excess tax revenues, in which case we say it is corrupt. Secondly, irrespective of the tax rate chosen, it may decide to pass *constitutional reform*. Constitutional reform is modelled as a move towards complete transparency regarding *c*: the true cost of the public good is announced and becomes known to all agents.[6] Once constitutional reform is undertaken, it remains in place, implying that future parties cannot levy taxes in excess of τ^c. That is, future corruption is not

[6] The importance of budget institutions and, in particular, the role of transparency in generating fiscal discipline is documented by Alesina, Hausmann, Hommes, and Stein (1999). Compelling evidence for our concept of constitutional reform is presented by Wallis (2005), who examines constitutional reforms at the state level in the US states in the mid-nineteenth century. Major transport infrastructure projects were ridden with corruption that led to a fiscal crisis in the early 1840s. Many states responded by writing new constitutions that increased the transparency of government borrowing and expenditure, and succeeded in reducing corruption.

possible. Constitutional reform is passed at the end of the period, implying that a reform passed in *t* will be applicable from *t*+1 onwards.

We suppose that there are two types of parties, *idealists* and *opportunists*, but that the type can not be observed by voters. There is a small proportion of idealist parties, denoted ε. If an idealist party were elected, it would set τ^c and try to pass constitutional reform, hence preventing any future politicians from extracting rents and leading to a high-human-capital equilibrium. We shall assume that with some probability v (close to zero) it fails in passing constitutional reform. Therefore, it is not possible for voters to distinguish between an idealist party which failed to pass the reform and an opportunistic one that chooses (strategically) to impose the competitive tax rate. An honest party is elected with a low probability, ε, hence we focus on the case in which an opportunist party is in power.

3.4. Reelection Probabilities

We now turn to the determinants of the probability of reelection. The only policy dimension is whether or not the party has been corrupt, and hence, ceteris paribus, a voter would not reelect a party that has been shown to be corrupt. In order to relate education to voting behavior, we assume that educated individuals can monitor the behavior of the party in power, for example, because they are informed about the cost of the public good and realize when the competitive tax level is or is not imposed. The unskilled, on the other hand, are unable to monitor the government. We suppose that the more educated individuals there, are the higher the probability that a corrupt party is caught, and in particular we assume that the probability of being caught is $L_{S,t}$.[7]

A party that is proven to be corrupt is not reelected, since when a new party is elected there is a probability ε that the new government is idealistic and sets the competitive tax. If the party behaves honestly, it can never be shown to be corrupt and is always reelected. The reelection probabilities at time *t* can then be expressed as a function of two factors: the party's behavior at *t*-1 and the number of skilled individuals at *t*. The reelection probabilities when the government has been honest or corrupt take the form, respectively,

$$p_H(L_{S,t}) = 1, \qquad (10a)$$

[7] More complex functions of L_S could be used. As long as they are increasing our qualitative results would not change.

$$p_C(L_{S,t}) = 1 - L_{S,t}. \qquad (10b)$$

Recall that the party can also pass constitutional reform, which imposes the competitive tax in all future times if it succeeds. Successful constitutional reforms are correctly observed by all agents, and the party that passed it is reelected with certainty, that is,

$$p_R = 1, \qquad \forall L_S. \qquad (10c)$$

The reason for this is that by passing reform the party "ties its hands" and makes it impossible for themselves to tax excessively. This commitment implies that voters are certain that the tax rate will be the lowest possible.[8]

The party then has two ways of increasing the probability of reelection next period. One is to be honest in the first period, forgoing the first period rent in order to obtain a second mandate. The other way to increase the reelection probability is to pass constitutional reform, which will ensure reelection whatever the level of education, but will prevent the party from extracting monetary rents in the future.

4. Party Behavior and the Dynamics of Education

4. 1. Corruption, Honesty and Reform

In order to examine the behavior of the party in power we have to define his objective function. We suppose that the incumbent party chooses the policy that maximizes the discounted expected monetary and non-monetary rents received by the party.

It is clear from our discussion above that an opportunistic party may strategically set τ^c over a number of periods.[9] There are then three possible strategies that we need to consider. The first one consists in the party being corrupt in all periods. Note that in this case, there will be no changes in the number of skilled individuals, i.e. $L_{St} = L_{S0} = L_S \forall t$, implying that the monetary rent is the same in all periods. The expected payoff is given by

$$V_C(L_S) = (u + \pi(L_S)) \sum_{t=0}^{\infty} \left(\frac{1 - L_s}{1 + \delta} \right)^t = \frac{1 + \delta}{\delta + L_S} (u + \pi(L_S)), \qquad (11a)$$

[8] This assumption rules out a world were voters punish a party for his past behavior.

[9] Note that a dishonest party could set a tax rate above $\hat{\tau}_s$ such that nobody wants to become skilled next period and hence their probability of reelection increases at the cost of a lower rent. We rule out this possibility. We may justify it by assuming that there exists an outside option for skilled workers, say emigration, which is good enough to justify education and therefore negative vote for the party.

where δ is the discount rate. There are two effects of the level of education on the payoff from being corrupt: a more educated labor force increases the monetary rent but also raises the probability of being caught. Depending on parameter values one or the other effect will dominate, as we will see below.

A second strategy consists of being corrupt in the first period, getting profits $\pi(L_S)$ and then trying to pass reform. Should the reform fail, a new government is elected**,** The expected payoff is

$$V_{CR}(L_S) = \pi(L_S) + u + \frac{1}{1+\delta}\left[(1-v)\frac{u(1+\delta)}{\delta} + v(1-L_s)V_{CR}(L_s)\right],$$

which can be expressed as

$$V_{CR}(Ls) = (1+\delta)\frac{u + \pi(L_S) + u(1-v)/\delta}{1+\delta-v(1-Ls)}. \qquad (11b)$$

The payoff $V_{CR}(Ls)$ is strictly increasing in the supply of skills when v is small. In this case, trying to pass constitutional reform is almost always successful and therefore almost ensures reelection. Consequently, the effect of L_S on the monetary rent dominates. When this strategy is chosen, corruption will be short-lived, and the reform will result in low taxes which would eventually lead to an increase in skilled labor. In other words, there will be institutional change that will eventually lead to an education expansion. Note also that this strategy dominates being honest in all periods, which would have a payoff of $(1+\delta)u/\delta$. Also, a strategy of being corrupt for more than one period is not possible in this infinite horizon model. This would imply that at all times the incumbent party would choose to be corrupt for *T* periods, resulting in pervasive corruption.

The third strategy we need to consider is one in which the party strategically chooses to induce education expansion. The reason why he would choose to do so is that by choosing the competitive tax rate for *N*-1 periods, the entire population would become educated. This has two effects on the strategies of the party. First, the probability of reelection of an honest government is such that the party remains in power next period. Second, the increase in the number of skilled raises output and hence the rents obtained at *N* as compared to those at *N*-1. Note, however, that once the total labor force is educated, the probability of a corrupt government being caught is 1, hence the party would choose to pass constitutional reform at *t*=*N*. That is, the

party would be honest for *N*-1 periods, corrupt at *N*, and then pass reform, which would allow it to remain in power from *N*+1 onwards. The expected payoff is

$$V_{HCR} = \frac{\pi(1) + (1-v)u(1+\delta)/\delta}{(1+\delta)^N} + \sum_{i=0}^{N-1} \frac{u}{(1+\delta)^i} \qquad (11c)$$

In this case, educational expansion will occur first and institutional reform will follow. The payoff from this strategy is independent of the level of education. On the one hand, the monetary rents are independent of the current level of education, as corruption will occur only when the entire population is educated. On the other hand, the probabilities of reelection are not affected by education either, initially because honest behavior ensures reelection, and later on because constitutional reform guarantees it.

4.2. Education and the Incentives for Corruption

4.2.1. Productivity and Political Strategies

We need to examine in which circumstances a party chooses each of these three strategies. There are two possible scenarios depending on the initial distribution of wealth. The first is the case in which wealth inequality is low, i.e. $x_{u,0}$ is high. The initial wealth of the unskilled is close to the cost of education, and introducing the competitive tax would allow the children of the currently unskilled to study, leading to a skilled labor supply of 1 next period. Alternatively, if initial wealth inequality is high, that is $x_{u,0}$ is low, then *N* periods of low taxes would be required for the unskilled to become educated. In this subsection, we suppose that inequality is low, that is, *N*=1, and examine the effect of productivity in the choice of strategy. The next subsection focuses on the effect of different degrees of inequality.

When inequality is low, substituting for rents from (9) gives the payoffs from the three possible strategies as

$$V_C(L_S) = \frac{1+\delta}{\delta + L_S}(u + a(1+\varphi L_S)) \qquad (12a)$$

$$V_{CR}(Ls) = (1+\delta)\frac{u + a(1+\varphi Ls) + u(1-v)/\delta}{1+\delta - v(1-Ls)} \qquad (12b)$$

$$V_{HCR} = a\frac{1+\varphi}{1+\delta} + \frac{u}{\delta}\left(1+\delta - \frac{v}{1+\delta}\right) \qquad (12c)$$

The level of education plays a crucial role in the choice between these strategies. First note that V_{HCR} is constant for all L_S, while V_{CR} is increasing and convex in L_S when v is small. The payoff from being utterly corrupt, V_C, is increasing and concave if $a > \underline{a}$, and decreasing and convex otherwise, where $\underline{a} \equiv u/(\delta\varphi - 1)$. That is, whether it is increasing or decreasing crucially depends on the skill premium and the ego rent. The positive effect of education is that it increases the monetary rent, and this effect will be stronger the larger the skill premium is, making it more likely that V_C is increasing. The negative effect is that it reduces the probability of reelection and implies a loss of ego rents, hence the larger the ego rent, *u*, the more likely it is that the schedule is decreasing. In what follows we suppose that $a > \underline{a}$, i.e. assume that *u* is not too large, implying that the V_C schedule is increasing.[10]

We shall assume that the probability of failure v for reform goes to zero. Comparing the three functions (see appendix) we can show that at L_S=0 it is the case that $V_{CR}(0) < V_C(0)$ for all parameters, and $V_C(0) < V_{HCR}$ if and only if $A_u > \overline{A}$, where $\overline{A}$ is defined in the appendix. This implies that for low values of education, there are two possible strategies, either V_C or V_{HCR}. The former will dominate if unskilled productivity is sufficiently high. For L_S=1, we have $V_C(1) < V_{CR}(1)$ and $V_{HCR} < V_{CR}(1)$, that is, the strategy of being corrupt for one period and passing reform will dominate for high levels of education.

Depending on parameter values three possible configurations appear, as depicted in figures 3 and 4.[11] Figure 3 considers the case of high unskilled productivity, that is $A_u > \overline{A}$. In this case, the strategy V_{HCR} is always dominated. The intuition for this is straight forward: a high level of A_u implies that the skill premium A_s / A_u is low, and the resulting expansion of education causes a small increase in monetary rents, which is hence always dominated. Two viable political strategies have to be compared: reform (11b) and full corruption (11a). The tradeoff faced by a corrupt party is receiving ego rents with certainty, or opting for ego and monetary rents with uncertainty. The value functions intersect only once, at the education level

[10] The results obtained when the schedule is decreasing are qualitatively similar. What is important for our results is that V_C increases more slowly than V_{CR}

[11] There are more possible configurations, as discussed in the appendix, but they amount to the same choices of strategies are those discussed here.

L_S^*, indicating that for economies with a labour supply smaller than L_S^*, the party is permanently dishonest, since the probability of being re-elected is high. For societies with sufficiently educated populations, $L_S > L_S^*$, politicians opt for constitutional reform after an initial period of corruption. The reason for this is that the high level of education implies a low re-election probability. The party then chooses to commit to low future taxes by passing constitutional reform and obtains the ego rent from period 2 onwards with probability 1.

Figure 3 about here

The alternative scenario is that of a high skill premium, that is $A_u < \overline{A}$. In this case, the strategy V_{HCR} always dominates for low values of L_S. The reason for this is that if the competitive tax rate τ^c is chosen at *t*, the entire population will be educated, $L_{s,t+1} = 1 > L_{s,t}$, while setting τ^* would leave the size of the skilled population unchanged. Increasing the skilled population has two effects on the strategies of politicians. First, it raises output and hence the rents obtained at *t*+1 as compared to those at *t*. Second, the probability of reelection of a dishonest government becomes null, and hence the government will want to pass constitutional reform in the second period. This strategy dominates for low initial levels of L_S, as in this case there is a large increase in the monetary rent compared to what could have been obtained by being corrupt at *t*.

There are two possible cases, depicted in figures 4a and 4b. For intermediate values of unskilled productivity, that is if $\underline{A} < A_u < \overline{A}$, where $\underline{A}$ is defined in the appendix, all three strategies will be chosen at some point. This is represented in figure 4a, where we can see that for low levels of education V_{HCR} will be preferred, for intermediate levels the government will be utterly corrupt, while for highly educated populations V_{CR} will dominate. The case of low unskilled productivity, i.e. $A_u < \underline{A}$, is depicted in figure 4b. A low productivity of the unskilled implies that the rent $\pi(L_{s,t})$ is low; the loss due to a positive probability of not being re-elected is too large relative to the monetary rent and hence the strategy V_C is dominated for all

values of L_S. If the level of education is low, i.e. $L_S < \tilde{L}$, the strategy V_{HCR} will be preferred as it is worth waiting one period in order to get the high monetary rent stemming from the increase in the educated labor force; for high levels of education, V_{CR} dominates as the increase in the monetary rent is no sufficient relative to the discount factor.

Figure 4 about here

We can summarize these results in the following proposition:

Proposition 2: Political Equilibria and Productivity

Consider an economy with low inequality. Then

(i) In countries with high unskilled productivity, there exists a threshold level of education L_S^* *such that for* $L_S < L_S^*$ *the party is permanently corrupt while for* $L_S \geq L_S^*$, *the party implements constitutional reform.*

(ii) In countries with intermediate levels of unskilled productivity there exist two threshold levels of education, L_s^{**} *and* L_S^* *, such that*

(a) for $L_S \leq L_s^{**}$, *the party engages in education expansion,*

(b) for $L_s^{**} < L_S < L_S^*$, *the party is permanently corrupt ,*

(c) for $L_S \geq L_S^*$, *the party implements constitutional reform.*

(iii) In countries with low levels of unskilled productivity there exists a threshold level of education, $\tilde{L}_S$ *, such that for* $L_S \leq \tilde{L}_S$, *the party engages in education expansion while for* $L_S > \tilde{L}_S$, *the party implements constitutional reform*

It is clear from our discussion that an increase in the productivity of unskilled workers raises not only national income, but also the incentives for corruption. This suggests that the presence of natural resources or an international transfer of technology which is complementary with unskilled labor will raise the incentives for corruption.

4.2.2. Inequality and political strategies

When wealth inequality is high, *N* periods of low taxes are needed for the unskilled to accumulate sufficient wealth to become educated, *N* being larger the greater the degree of inequality is. The payoff from being permanently corrupt and from introducing constitutional reform are unchanged, and still given by (12a) and (12b). However, the payoff from introducing education expansion now depends on the number of periods of low taxes required for the unskilled to be able to afford education. For simplicity of exposition, we let ν=0. Then, we can express the payoff from educational expansion as

$$V_{HCR}(N) = a\frac{1+\varphi}{(1+\delta)^N} + \frac{1+\delta}{\delta}u \qquad (12d)$$

The effect of higher inequality is to shift down the V_{HCR} schedule, as depicted in figure 5. The continuous horizontal line represents a low level of inequality (low *N*), and in this case we can see that persistent corruption never dominates. The dashed line depicts an intermediate value of *N*, and in this case V_C dominates for intermediate levels of education, while with high inequality (dotted line) the strategy V_{HCR} is never chosen. The intuition for these results is straight forward. The more unequal the economy is, the longer it takes to achieve education expansion. Since there is discounting, the present value of the monetary rent will be lower the larger *N* is, and hence V_{HCR} is less likely to dominate. Indeed, when we compare this expression to equation (12a), we can see that $V_C(0) < V_{HCR}$ if and only if $A_s\delta/(1+\delta)^{N+1} > A_u$.

Figure 5 about here

From inspection of figure 5, we have the following proposition:

Proposition 3: Political Equilibria and Inequality

Consider an economy with a low level of unskilled productivity. There exist two threshold degrees of inequality, $\overline{N}$ *and* $\underline{N}$*, such that*

(i) For low levels of inequality, i.e. $N < \underline{N}$, V_{HCR} *dominates for low values of* L_S *and* V_{CR} *high ones.*

(ii) *For intermediate levels of inequality, i.e.* $\underline{N} < N < \overline{N}$, V_{HCR} *dominates for low levels of education* $L_S \leq L_s^{**}$, V_C *dominates for* $L_s^{**} < L_S < L_S^*$, *and* V_{CR} *dominates for* $L_S > L_S^*$. *The threshold value* L_s^{**} *is lower the greater inequality is.*

(iii) *For high levels of inequality, i.e.* $N > \overline{N}$, V_C *dominates for low and intermediate levels of education* $L_S < L_S^*$, *and* V_{CR} *dominates for* $L_S > L_S^*$.

Proposition 3 indicates that inequality plays an important role in the choice of strategy. For a given skilled labor force, L_S, the more unequal the distribution of wealth, the more likely it is that corruption prevails.

4.2.3. The Evolution of Wealth

We can now examine the dynamics of wealth under the three possible strategies. If the party is always dishonest, the economy maintains the two class distribution with the same number of skilled and unskilled as there were initially, and their steady state wealth will converge to $\bar{x}_u(\tau^*) < e < \bar{x}_s(\tau^*)$. Output will be low for two reasons, because the high tax rate implies a low capital-labor ratio, and because a fraction of the labor force remains uneducated.

If constitutional reform is passed at time *t*, the skilled labor force will be unchanged for *N*-1 periods. However, the reduction in the tax rate allows the unskilled dynasties to increase their bequest, and at *N* all the labor force will become skilled. In this case, development is fostered by political reform, with reform taking place first and triggering the education expansion. Lastly, the government may choose to induce an increase in education at period *N* that will then be followed by institutional reform at *N*+1. The economy will escape from the poverty trap, but in this case, the education expansion occurs first and is then followed by institutional change.

We can summarize these results in the following proposition:

Proposition 4: Political Strategies and Long-Run Development

Consider the three possible strategies chosen by the party:

(i) *If the party is permanently corrupt the economy remains in a low-education, low-output, high-inequality trap.*

(ii) *If the party engages in education expansion, the increase in educational attainment leads to high output and an equal distribution of wealth.*

(iii) *If the party implements constitutional reform, wealth accumulation eventually allows the unskilled to acquire education, leading to high output and an equal distribution of wealth.*

5. Discussion and Conclusions

Propositions 2, 3 and 4 summarize the possible patterns of development (or lack of it) in an economy with endogenous education and corruption. Three main results emerge. The first one concerns the relationship between education and corruption at the aggregate level. Although we have postulated a positive relationship between education and political knowledge at the individual level, this does not translate into a monotonic relationship between the aggregate level of education and politicians' behavior. The reason for this is the strategic choice of actions by politicians. Education tends to increase the rent obtained by a corrupt party, but reduces the probability of reelection next period. When a large fraction of the population is educated, the probability of reelection of a corrupt party is low, which will lead to constitutional reform that in turn impedes future corruption. The rent effect dominates for intermediate levels of education, and in this case the economy remains in a low-education, low-income, high-corruption trap. For low levels of education, and if unskilled productivity is not too high, opportunist politicians will induce an education expansion that results in high-education, high-output and no corruption.

The second implication of our analysis is that there are two possible paths to development. In one case, constitutional reform reduces corruption and this eventually leads to education expansion. That is, an improvement in institutions brings about high education and equality. Alternatively, low taxation results in a highly educated labor force, and this will in turn prevent corrupt behavior. Institution-led development is likely to occur in highly educated economies, while education-led development can only take place if the productivity of the unskilled is low and the distribution of wealth not too unequal.

Lastly, we have shown that countries with very low levels of education may fare better in the long-run than those with intermediate levels of education. There are two circumstances under which the former are likely to get out of the poverty trap. One is the case of a low productivity of the unskilled. Because productivity is low,

monetary rents are low. The party sets a low tax rate and induces education expansion, thus increasing next period's monetary rents. In doing so, however, he impedes corruption in the future. Resource-rich countries, in which the unskilled have a high productivity in the extraction of natural resources, are hence more likely to remain locked in a high-corruption/low-education equilibrium. This helps explain the empirical evidence, which indicates that resource abundance may lead not only to growth rates but also to poor governance.[12]

The other scenario is the case of an economy with a large proportion of uneducated labor but low wealth inequality. In this case, honest behavior one period can allow the entire labor force to become educated thus increasing the rents obtained from corruption in the second period. The education expansion, however, means an increase in the political knowledge of the electorate and rules out corrupt behavior for any future government.

The cases we have identified in the model can be illustrated with two examples. First, Latin American economies have been, to a large extent, characterized by poor institutions and widespread corruption. In the mid-20th century these were economies with intermediate levels of education. Rents were sufficiently high to create the incentives for corruption, but the level of political knowledge of the electorate was not high enough to identify corrupt behavior. As a result, these economies were locked in a bad-institutions/low-output/high-inequality equilibrium.

Our second example concerns East Asian and sub-Saharan African economies, which in the mid-20th century, at the end of colonization, were both characterized by extremely low levels of educational attainment. In the 1950s the perception among development economists was that the serious problem was faced by East Asia. African countries were resource rich, and natural resources would bring in the revenues needed to trigger growth (see Hance, 1956); East Asian economies were uneducated, resource poor, and highly populated, and hence had no way of escaping the poverty trap. Yet, the next few decades witnessed a massive increase in both education and per capita incomes in the Asian economies and stagnation in most African countries (Temple, 1999). Our analysis suggests a possible explanation for these observed disparities. As well as poor, East Asian countries were relatively equal (see the discussions in Benabou, 1996, and Aghion, Caroli and García-Peñalosa,

[12] See Bulte, Damania and Deacon (2005) for empirical evidence, and Robinson, Torvik and Verdier (2005) for an analysis of institutional determinants of the resource curse.

1999). The model predicts education-led development, with an expansion in educational attainment leading to higher output levels though not necessarily to institutional change. This is precisely what took place in the last decades of the 20th century. In Africa, abundant natural resources made the productivity of the unskilled high, leading to large potential rents. Corruption prevailed, impeding education and maintaining low output levels.

A number of questions remain. The most important one is that we have emphasized the importance of the level of productivity in an economy in order to determine the strategy chosen by politicians. A more detailed analysis of how productivity is affected by the presence of natural resources, trade, or international technology transfers would be welcome.

Appendix

In this appendix we compare the three schedules determining the payoff of parties. Recall that when *N*=1, there are three possible strategies,

$$V_C(Ls) = \frac{1+\delta}{\delta + Ls}(u + a(1+\varphi Ls))$$

$$V_{CR}(Ls) = \frac{u + a(1+\varphi Ls) + u(1-v)/\delta}{1+\delta - v(1-Ls)}$$

$$V_{HCR} = a\frac{1+\varphi}{1+\delta} + \frac{u}{\delta}\left(1+\delta - \frac{v}{1+\delta}\right)$$

First note that V_{HCR} is constant for all L_S. When v is small, the function V_{CR} is a convex function increasing in L_S, when $a > \underline{\underline{a}} \equiv \frac{vu(1+\delta-v)}{\delta((1+\delta)\varphi - v(1+\delta))}$ and takes the values $V_{CR}(0) = \frac{u + a + u(1-v)/\delta}{1+\delta-v}$ and $V_{CR}(1) = \frac{u + a(1+\varphi) + u(1-v)/\delta}{1+\delta}$ at $L_S = 0$ and $L_S = 1$, respectively. Lastly, differentiating the function V_C we have

$$V_C^{'} > 0, V'' < 0_C \Leftrightarrow a > \underline{a} \equiv \frac{u}{\delta\varphi - 1}$$

That is, the function is increasing and concave if $a > \underline{a}$, and decreasing and convex otherwise. It takes the values $V_C(0) = (1+\delta)(u+a)/\delta$ and $V_C(1) = u + a(1+\varphi)$ at L_S=0 and L_S=1. In what follows we suppose that $a > \underline{a}$.

In what follows we take v to zero and assume that $a > \underline{a}$. Comparing the three functions and the end points we can show that

- $V_{CR}(0) < V_C(0)$
- $V_{HCR} < V_{CR}(0)$ if and only if $\delta > \varphi$
- $V_{HCR} < V_C(0)$ if and only if $1 + \delta + 1/\delta > \varphi$
- $V_C(1) < V_{CR}(1)$ and $V_{HCR} < V_{CR}(1)$
- $V_{HCR} < V_C(1)$ if and only if $a > \overline{a} \equiv \frac{1+\delta}{\delta^2}\frac{u}{1+\varphi}$
- $V_C(\tilde{L}) > V_{HCR} = V_{CR}(\tilde{L})$ if and only if $a > \tilde{a}$, where $\tilde{a} \equiv u\left(\frac{1+\delta}{\delta}\right)^2 \frac{\varphi - \delta}{(1+\varphi)^2}$

and $\tilde{L} \equiv (\varphi - \delta)(\varphi(1+\delta))$.

Depending on parameter values, four possible cases emerge: the three examined in the case, as well as one obtained when $\delta > \varphi$. It can be easily verified that in this case V_{HCR} always lies under the two other schedules, and hence the equilibrium will be equivalent to that obtained in figure 4. We therefore concentrate on what happens depending on whether $1 + \delta + 1/\delta > \varphi$ holds or not. Note that if

$1+\delta+1/\delta>\varphi$, then it always holds that $a>\tilde{a}$. However, for $1+\delta+1/\delta<\varphi$ we must distinguish between the case $a>\tilde{a}$ and that in which $a<\tilde{a}$.

In order to be able to better interpret these two conditions, we can use the fact that $\varphi=A_s/A_u-1$ and $a=A_u(1-\alpha)^2\left(\alpha^2/r\right)^{\alpha/(1-\alpha)}(1-c\phi)^{1/(1-\alpha)}$, to express the condition $1+\delta+1/\delta>\varphi$ as

$$A_u>\overline{A}\equiv\frac{\delta A_s}{(1+\delta)^2}, \tag{C1}$$

while $a>\tilde{a}$ can be expressed as

$$A_u>\underline{A}\equiv\frac{A_s}{1+\delta}\left[1-\frac{uA_s}{(1-\alpha)^2\left(\alpha^2/r\right)^{\alpha/(1-\alpha)}(1-c\phi)^{1/(1-\alpha)}}\left(\frac{1+\delta}{\delta}\right)^2\right]. \tag{C2}$$

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Figure 1: Equilibrium Inequality

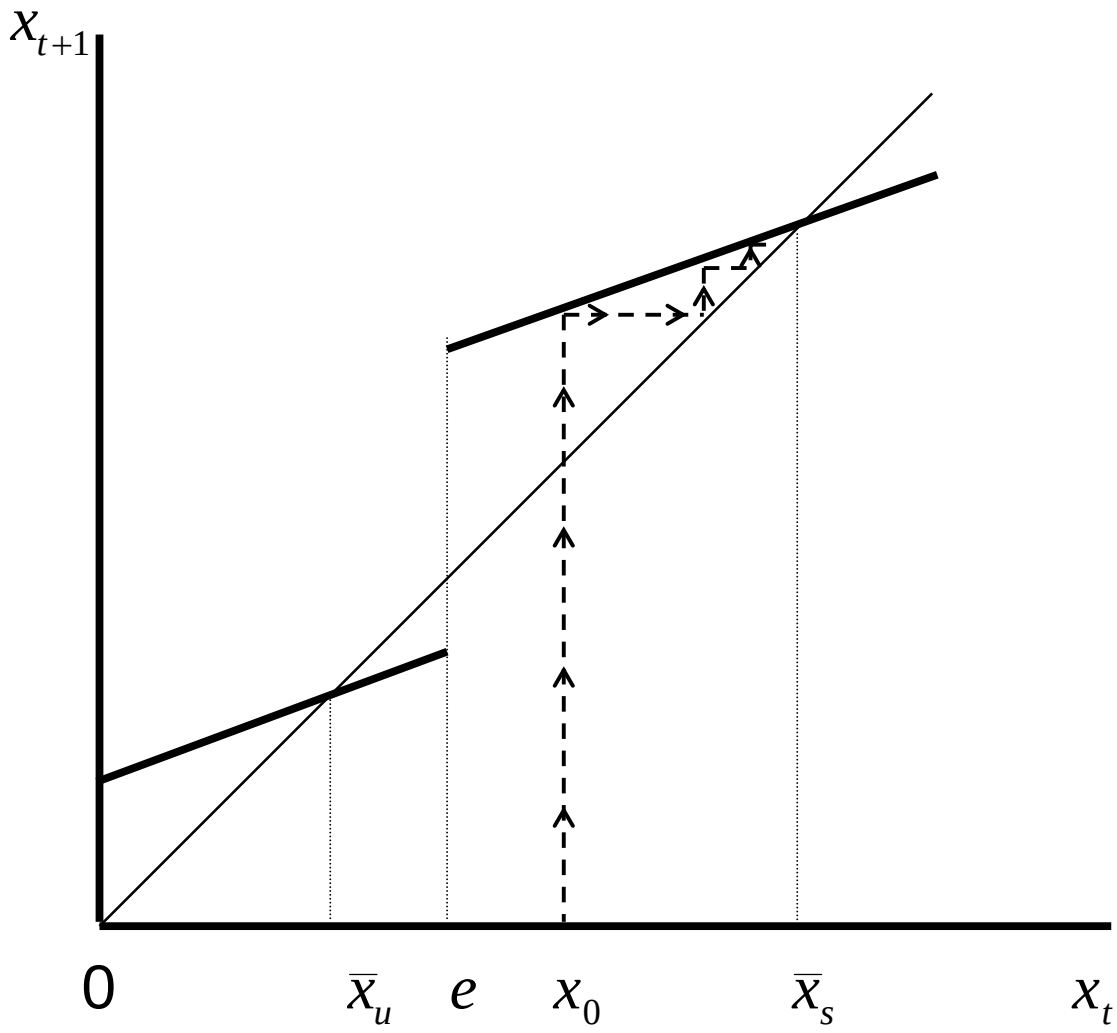

Figure 2: Bequests and Taxation

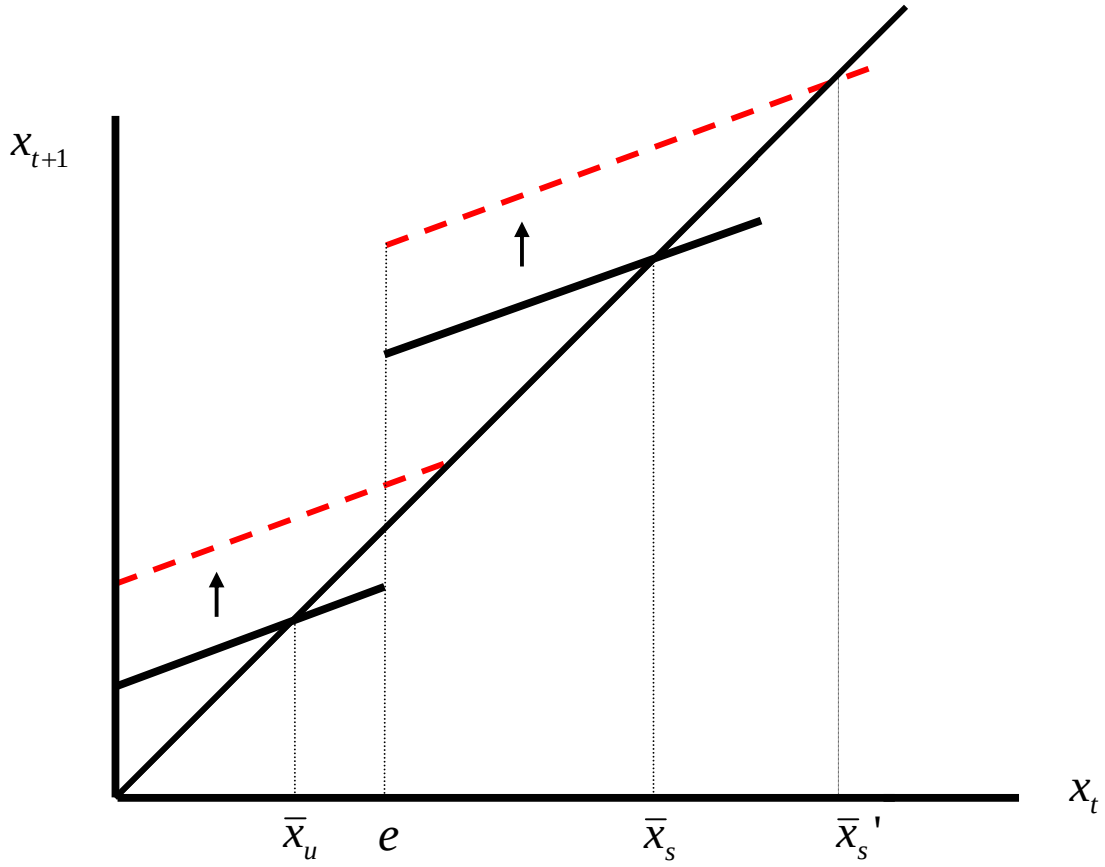

Figure 3: Dynamic Effects of Lower Taxes on Education

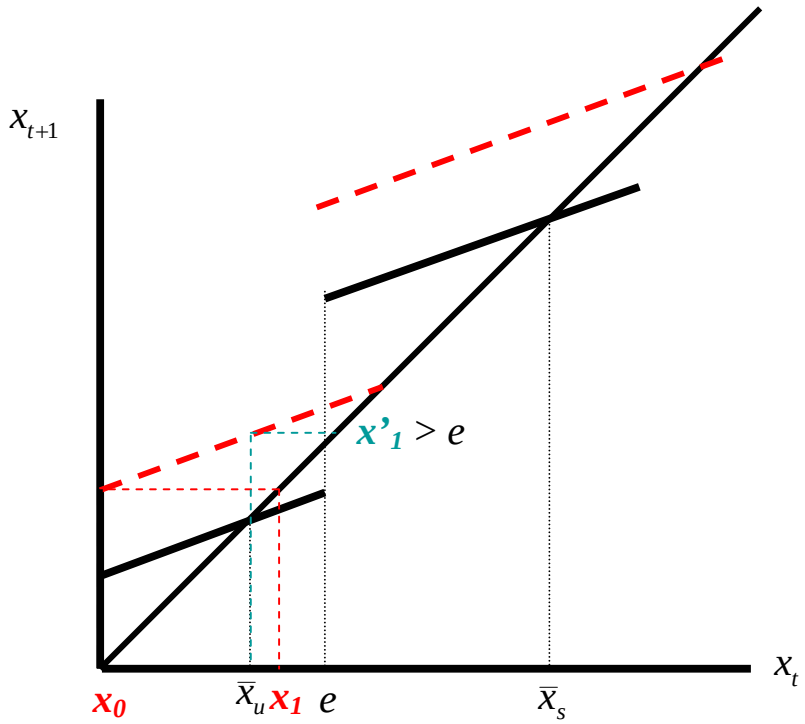

Figure 4: Political strategies with $A_u > \overline{A}$

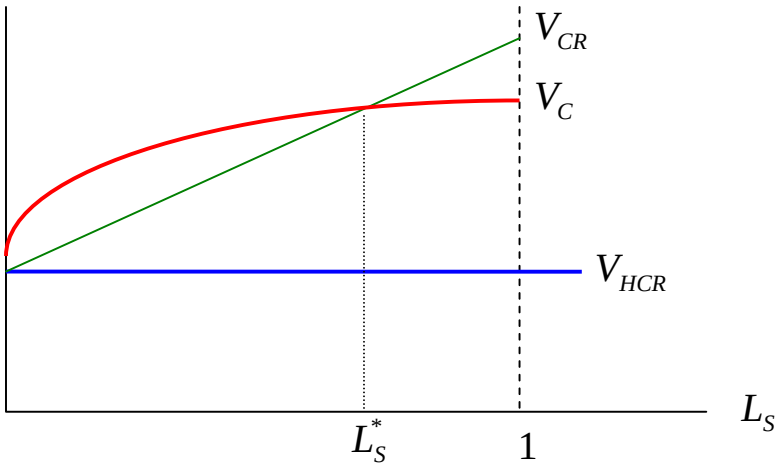

Figure 5a: Political strategies with $\underline{A} < A_u < \overline{A}$

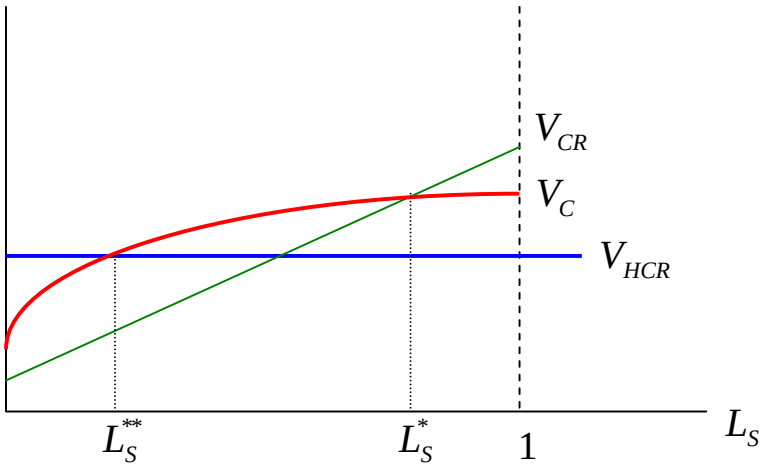

Figure 5b: Political strategies with $\underline{A} > A_u$

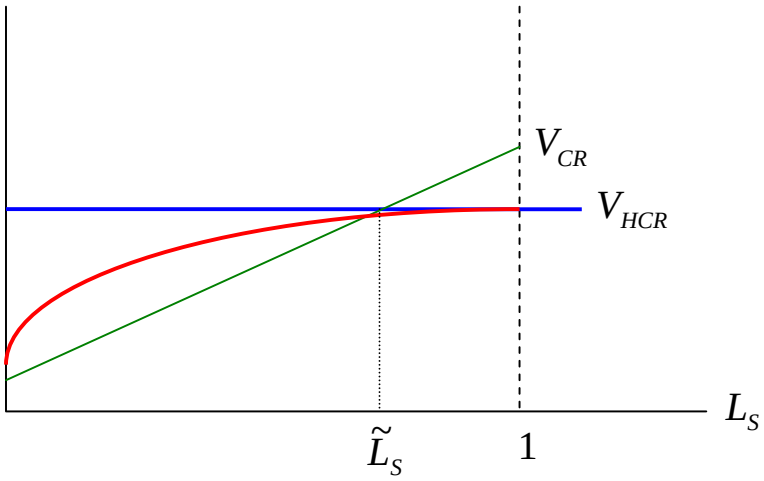

Figure 6: Inequality and political strategies