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Public education, growth, and political regimes

Mayo Mauricio Armellini

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**Thesis submitted for the degree of
PhD in Economics**

Durham Business School, Durham University



June 2009



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ABSTRACT

Public education, growth, and political regimes

by Mauricio Armellini

This study investigates some of the reasons why countries spend public money on education, the impact of education on economic growth, why and how political regimes interfere in the impact of education on growth and how education can be a lever for political change. Conclusions are derived from theoretical models and modern econometric techniques.

The research puts forward altruism as one of the determinants of the cross-country variation in public subsidies to education: altruism tends to act as a deterrent for public subsidies to education. The research into altruism and education subsidies exploits previously underused data to present a new proxy to make international comparisons between levels of altruism.

The analysis of this thesis shows how the defence-education trade-off constrains the extractive powers of a dictator, it illustrates why dictatorial regimes may have incentives to undermine the effects of education on economic growth, and how this relates to regime transitions. The analysis also demonstrates that more redistributive policies should be expected in democracies than in non-democracies.

Finally, this research provides evidence of the more tangible effects of education on growth once the democratic environment is taken into account, clearing the 'micro-macro' paradox of the effects of education on income.

This thesis sets an agenda for future research, including the need to observe the evolution of altruism over time and how it relates to variations in cross-country expenditure in education. Also, it demands a continuous re-test of the relationship between education and growth under different political regimes as longer and more informative time series become available.

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Chapter 1

Introduction



Economic growth literature has been interested in understanding the dynamics and the determinants of economic growth. Human capital is usually included in the list of possible determinants of growth, not only in the theoretical models, but also in the regressions that try to identify the determinants of growth empirically. This is supported by the idea that a more educated workforce should be more productive, and also by the fact that a cross sectional observation of countries show that the richest countries are those that have a more educated population.

Although the expected benefits of education are not limited to a higher level of output (other benefits in welfare include violence reduction, health prevention, etc), the objective of promoting education is usually supported by an alleged causal link from education to growth. This has been taken as an axiom for economic policy, so most (if not all) of the countries in the world do nowadays spend a significant part of their budgets in public education expenditure.

While the incidence of education on the determination of personal income has been well documented by the scholars (see the first two subsections below), the same is not true when it comes to the effects of education on macroeconomic growth, where different data sets and models have yielded contradictory results. This raises the question of whether poor countries should not re-direct their public budgets, decreasing the expenditure in education and increasing other social policies that may help reduce poverty more effectively.

This thesis investigates some of the possible reasons why countries spend public money in education in the way they do, why different countries devote different proportions of their resources to public education, what is the impact of education on economic growth, why and how different political regimes interfere in the impact of education and growth, and how education can be a driver of political change.

Literature review and motivation

The Micro-Macro paradox

The relationship between education and economic growth has been extensively investigated, and is still a growing area of research (see for example the reviews of Krueger and Lindahl 2001, Temple 2001b or Gradstein, Justman and Meier 2005). However, the question of how education affects economic growth is not yet fully resolved.

One of the issues that causes controversy is that of the apparent contradictions between the effects of education on the growth of personal income (microeconomic effect) and on macroeconomic growth (macroeconomic effect). Regarding the microeconomic effect, the consensus is that on average, more education tends to increase an individual's earnings. For example, Psacharopoulos (1993), Psacharopoulos and Patrinos (2002) and Michaelowa (2000) show international comparisons and conclude that people with more education tend to have higher wages, a result that seems to be consistent across countries and for the various years analysed. As Pritchett (2001) puts it, *"people with more education have higher wages. This is probably the second (after Engel's law) most well-established fact in economics"* (Pritchett 2001, page 368).

The standard procedure to calculate the effect of education in individuals' earnings has been to use the Mincerian wage equation (Mincer 1974):

$$(1) \quad \ln W_i = \beta_0 + \beta_1 S_i + \beta_2 X_i + \beta_3 X_i^2 + \varepsilon_i$$

where $\ln W_i$ is the natural log of the wage of individual i , S_i is years of schooling, X_i is years of labour market experience, and ε_i is the disturbance

term. The coefficient on schooling is usually interpreted as the private return to education, and empirical estimates suggest that the private rate of return to an additional year of schooling is typically between 5% and 15% (Temple 2001b).

Observing across countries, Psacharopoulos and Patrinos (2002) show that the return to education is decreasing on education and on income, i.e., more education yields higher returns (in terms of income) in poorer countries than in richer countries. In particular, Psacharopoulos reviews and expands his original research on several occasions, always finding similar results (1973, 1981, 1985, 1993, 2002 with H. Patrinos).

The results obtained by Psacharopoulos are consistent with Griliches and Mason (1972). Observing a sample of military veterans from the United States, Griliches and Mason (1972) conclude that differences in schooling contribute to explain differences in income. The consistency of positive effects of education on income at the microeconomic level suggests that something similar should happen at the macroeconomic level.

As Pritchett (1996, 2001) points out, education externalities, if existent, should make macroeconomic effects greater than microeconomic effects. If education is good for growth, then when an individual receives education it should not only increase their productivity and consequently their personal income, but also the spillovers of a more educated and more productive individual should benefit the rest of the economy as well. However, the results obtained at macroeconomic level tend to show that macroeconomic returns to education are lower than the microeconomic returns (in other words, that one additional year of education has a positive impact on the income of the individuals, but its effect on macroeconomic income is less clear). Pritchett (1996) refers to this as the 'micro-macro paradox', because initially, we should expect macroeconomic effects to be at least as important as the microeconomic effects (plus possible externalities).

The absence of clear positive macroeconomic returns to education feeds into the discussion referred above about public expenditure in education: if there is not consistent evidence of the positive macroeconomic effects of education, should governments spend at all in public education?

Education and economic growth

Some of the divergences found at macroeconomic level are due to the framework in which the relationship between education and growth is analysed. Aghion and Howitt (1998) distinguish between two approaches. One approach, which they identify with Lucas (referring to Lucas 1988), is associated with the idea of growth being primarily driven by the *accumulation* of human capital. According to this approach, the differences in the growth rates observable across countries are primarily due to differences in the rates of human capital accumulation over time. The authors identify the second approach with Nelson and Phelps (1966). According to this approach, growth is driven by the *stock* of human capital, which has an effect on a country's ability to innovate and generate technical progress, which in turn affects economic growth.

Aghion and Howitt (1998) suggest that both of the previous approaches can be 'true' at the same time, because they may be referring to different aspects of human capital. They propose a distinction between increases in the human capital stock by improving basic education for all workers (for example improving literacy), and raising the human capital stock by training a small number of workers to higher education levels. Whereas they associate the first aspect to a normal input in the growth process (and could be associated with what they call the Lucas approach), the second aspect could be more relevant to innovation (and associated with the Nelson and Phelps approach). In this line, Aghion, Meghir and Vandenbussche (2006)

analyse data for a sample of 19 OECD countries every five years between 1960 and 2000. They conclude that for countries closer to the technological frontier, the greater growth-enhancing impact of education will come from the level of high-skilled labour available, as this will allow those countries to innovate and grow. However, for countries farther away from the technological frontier and with unskilled labour, imitation of technologies is the main engine of productivity growth. Observing the 48 continental states of the United States, Aghion et al (2009) find comparable results: expenditure in low level education is more growth-enhancing in the states that are farther away from the technological frontier.

Other differences in the empirical results obtained at macroeconomic level could be attributed to differences in the datasets used, or in the way that education is measured. In some cases they find positive effects of increased education on macroeconomic growth (see for instance Sylwester 2000 or Krueger and Lindahl 2001); in some cases they find weak or no direct effect of increased education on growth (see for example Temple 2001, Bosworth and Collins 2003, Pritchett 2004); and in some cases they find indirect effects through technical progress, as in Nelson and Phelps (Benhabib and Spiegel 1994). In the paragraphs below I discuss briefly each of these papers.

Benhabib and Spiegel (1994) estimate a Cobb-Douglas production function in which human capital is one of the factors of production. They regress macroeconomic growth (log differences in income) on changes in capital stock, changes in the size of the labour force, increase of the stock of human capital, log of initial income, a dummy for oil-exporting countries, geographical dummies, a measure of the size of the middle class (as a measure of income distribution), and a measure of political instability. They run their regressions using Ordinary Least Squares (OLS) for a set that contains between 115 and 40 countries (depending on the availability of data for each specification). They test different specifications and use different sources of data: for example, to account for human capital they use data from Kyriacou

(1991), Barro and Lee (1993) and data on literacy. Their results show consistently that the coefficient for the growth of human capital is non-significant to explain changes in income.

However, they introduce further specifications where they show that both the *level* of human capital and the interaction (multiplication) of the *level* of human capital times a measure of differences in technology across countries¹ have positive and significant effects on economic growth. Also, they present a last set of regressions in which the *level* of human capital has a positive and significant effect on the accumulation of physical capital. The authors' interpretation of their results is that the level of human capital has a significant effect on the rate of domestically generated technological innovation and in attracting physical capital from abroad, which, in turn, both have a positive effect on economic growth.

Sylwester (2000) observes the relationship between public education expenditure and economic growth. Using a sample of 54 countries, the author regresses the growth of Gross Domestic Product (GDP) between 1970-1985 on initial real GDP (year 1970), initial level of human capital (year 1970), initial income inequality (year 1970), the average of the ratio of public education expenditures to output from 1970 to 1985, and the same variable averaged for the period 1960-1964. Sylwester (2000) finds that contemporaneous education expenditure has a negative effect on economic growth: when both variables are taken for the period 1970-1985 the effect of public education expenditure is negative. However, education expenditure appears to have a positive long-run effect: education expenditure in the period

¹ Their measure of the technology gap is $\left(\frac{Y_{\max} - Y_i}{Y_i} \right)$, where Y_{\max} is the initial income per worker of the country with highest income, and Y_i is the initial level of income of each country. The authors argue that the technology gap, defined in this way, captures the changes in income due to 'catch up' effects.

1960-1964 has a positive effect on economic growth in the period 1970-1985. The author concludes that this may be one of the reasons why part of the literature fails to find a positive effect between the growth of human capital and economic growth: if looked at in the short-run, the effect of education expenditure on growth is negative, whereas looked at in the long-run, the effect is positive.

Krueger and Lindahl (2001) review the conflicting evidence on the effect of education on economic growth. They propose that measurement errors in education may account for at least some of the contradictory results. To illustrate this, they examine the relationship between two measures of the change in average years of schooling used in previous research, and find that the correlation is too low. This suggests that an important portion of the measured change in the average years of schooling is non-informative.²

The authors find that in regressions that look at changes in short periods of time (i.e. five years), changes in education do not appear with a significant positive sign when used as a regressor to explain economic growth. When the same is done over longer periods of time (ten- or twenty-year periods), changes in education become significant to explain economic growth. Krueger and Lindahl (2001) argue that in short periods of time, changes in the variables used to map for education have low informational content relative to their measurement error, whereas over longer periods of time, real changes in education will predominate over the measurement error they contain. In consequence, they run regressions over different periods of time and conclude that changes in education are positively associated with economic growth once measurement error in education is accounted for.

Temple (2001) reviews the failures of previous research and revisits the empirical data, to conclude that “*the aggregate evidence on education and*

² I discuss the problems of measurement in the data further below.

growth, for large samples of countries, continues to be clouded with uncertainty” (Temple 2001 page 916). However, he stresses the fact that it is the level of schooling (rather than the change in schooling) what has a positive effect on subsequent economic growth. In another piece of research this author is ‘optimistic’ in the sense that he thinks that a positive relationship does exist between education and economic growth, though he admits that he cannot provide convincing empirical evidence for this: “the results we have provide some grounds for optimism [...]. This suggests that better data, and more sophisticated methods, may yet lead to a steady improvement in the precision of our estimates of the growth effects of education” (Temple 2001b, page 20).

Bosworth and Collins (2003) claim that most of the variability of the empirical results obtained for the effects of education on growth are due to variations in the sample of countries observed or definitions used, the time periods covered, measurement problems, and the inclusion of additional explanatory variables. Also, they point at unrealistic expectations: given that the change of the average years of schooling changes very slowly, its effects on output may be difficult to detect in the cross-country data. According to these authors, the failure to replicate the microeconomic results at macroeconomic level could be due to at least three factors: (i) the social returns to education may indeed be lower than the private returns; (ii) there are problems with measurement error in the data (more on this below); and (iii) cross-country variations in educational attainment may fail to account for variations in the quality of education.

They regress the growth in output per worker over 1960-2000 on the growth of physical capital per worker, growth in human capital per worker, initial level of average years of schooling, educational quality and a set of initial conditions. Their measure of educational quality is based on the results of international tests of academic performance and mathematics in 1965-1991 (a discussion on this kind of measure is presented below). They conclude that educational quality is positively and significantly related to the growth in

output per worker only if the control for the quality of the government institutions is not included. When the quality of the government institutions is included, the coefficient for educational quality remains positive, but smaller and statistically insignificant. They conclude that *“although the notion that the quality of education matters for growth is eminently sensible, we cannot distinguish it from more general concepts of the quality of government institutions [...] educational quality is highly correlated with measures of the quality of governing institutions and may simply be a proxy for this broader concept”* (Bosworth and Collins 2003, page 147).

Pritchett (2004) reviews the literature and finds four dimensions that affect the estimates of the effects of schooling on education: (a) mapping from years of schooling into an aggregate schooling capital; (b) the ‘production function’ assumed (mapping from schooling capital into output); (c) how physical capital enters the production function assumed; and (d) how measurement errors and the length of horizon of the data are dealt with. In particular, Pritchett (2004) argues not only that a positive link between education and growth is far from demonstrated, but also that one should be sceptical about the possibilities of finding such a link. The reasons for being sceptical are the five ‘*hard to*’ issues that the author identifies when trying to use schooling to explain economic growth: (i) it is hard to explain stable historical growth rates with trending schooling levels; (ii) it is hard to explain diverging output levels with converging schooling levels; (iii) it is not easy to explain falling growth rates in developing countries with rising schooling levels or stable growth in schooling; (iv) it is difficult to explain volatile growth rates with stable schooling levels and growing schooling; (v) it is harder to attribute big output effects to schooling when they create puzzles (negative growth of the residual) than when they solve puzzles (reduce a large positive residual).

In fact, Pritchett (2003) provides an explanation of why nearly all countries have public educational policies, without referring to the

macroeconomic effects of education on growth. He argues that schooling conveys beliefs, and the rulers of a nation are not indifferent about these beliefs. To control the beliefs embedded on instruction, powerful national regimes sought control of the beliefs instruction directly, so public schooling became a dominant form of schooling. Public schooling later expanded due to supply (pressure of strongly ideological regimes) or demand (pressure of increasingly powerful citizens), but was originally motivated by the need to control the beliefs of the population. For this reason, the author argues that the decision to spend more or less resources on education is driven by factors other than private, social or macroeconomic returns.

Chapter 2 of this thesis provides an alternative possible explanation to why countries spend different amounts in public education.

Introduction to Chapter 2

Using data for USA between 1963 and 1992, Krusell et al (2000) show that unskilled labour can be substituted with new capital equipment, which in turn increases the marginal product of skilled labour. In this way, every time better and cheaper capital becomes available, the marginal productivity of skilled workers increases, and that of unskilled workers decreases. The authors conclude that increasing the earnings of the lowest skilled requires more and better education, so they can use new equipment and raise their own productivity. A similar implication can be extracted from Psacharopoulos and Patrinos (2002; discussed above): according to their findings of decreasing returns to education on income, poorer countries should be expected to take advantage of those decreasing marginal returns, strongly committing to widening education across the population.

However, as I show in chapter 2, this has not happened: richer countries still devote proportionally more resources to public education than

poorer countries (see Keefer 2004), which probably explains why the difference in returns to education between rich and poor countries persists. What explains this cross-country distribution of the public spending in education? The results presented by Pscharopoulos and Patrinos (2002) and Michaelowa (2000) fail to explain why richer countries spend relatively more in education than poorer countries. Pritchett (2004) maintains that this is because ultimately, countries do not spend more or less in education just because it has higher or lower returns. As Pritchett himself admits, this contradicts a vast body of literature that justifies public expenditure on education on the existence of positive returns (see for instance Sheenan 1973).

In this thesis, chapter 2 addresses this issue by focusing on only one source of public expenditure on education (subsidies to private education expenditure) and by making use of a non-economic cause to shed light on the cross-country variation in public subsidies to education: altruism. Previous research explains and characterises intergenerational transfers and charitable giving through the concept of altruism. For example, Andreoni (1989, 1990) and Amegashie (2006) discuss the implications of 'pure' and 'egoistic' altruism for the utility that individuals receive from giving. They do not discuss how different degrees of altruism affect the optimal rate of education subsidy that the government should set. This is what I discuss in chapter 2.

If altruism explains (at least part of) the private educational transfers between parents and children, then altruism can be useful to explain part of the public transfers to education too. If people receive education early in their lives (when they are children), they cannot themselves decide how much education to provide; the older generations make this decision for them. If those who make the budgetary decisions assign different values to the education of future generations (they differ in the utility they obtain from educating their children, i.e., their intergenerational degree of altruism differs), then they will probably differ in the level of education subsidies that they will set. The initial research hypothesis of chapter 2 establishes that countries with

different levels of altruism will differ in the level of education subsidies that they will set. Specifically, the hypothesis is that countries with greater levels of private intergenerational altruism will need lower levels of public education subsidies; the intuition is that more private altruism necessitates lesser public subsidies to education, because more altruistic parents will naturally spend more on their offspring's education, substituting at least part of the public spending.

In chapter 2 I present a cross-country measure of educational subsidies that is new in the literature (there are no data available on educational subsidies at cross-country level) and also introduce a novel proxy for the degree of altruism for a cross section of countries. Previous research has used monetary transfers made by individuals as a proxy for altruism. For example, Bouhga-Hagbe (2006) looks at the remittances of migrant workers as an expression of their altruism. Andreoni (2006) compares altruism across countries by looking at the percentage of cash revenues of the non-profit sector that are received from philanthropy. Castillo and Carter (2002) run behavioural experiments in South African communities, and derive their measure of altruism from the amount of money that the individuals are willing to transfer in their 'dictator game'. However, these are not real proxies for altruism but rather some of its consequences. Using an under-exploited source of data I bring a new measure of altruism to the economic research. The proxy is derived from the World Values Survey³, question A026.⁴

³ European and World Value Survey four-wave integrated data file, 1981-2004, v.20060423, 2006. The European Values Study Foundation and World Values Survey Association. Aggregate File Producers: ASEP/JDS, Madrid, Spain/Tilburg University, Tilburg, The Netherlands. Aggregate File Distributors: ASEP/JDS and ZA, Cologne, Germany.

⁴ The question is "*Which of the following statements best describes your views about parents' responsibilities to their children?: A- Parents' duty is to do their best for their children even at the expense of their own well-being; B- Parents have a life of their own and should not be asked to sacrifice their own well-being for the sake of their children*". The results I use here are for all the respondents, regardless of whether they have children or not.

In principle, it could be argued that chapter 2 does not explicitly incorporate the concept of democracy, which is a central concept of this thesis. However, a closer look shows otherwise. This is not only because the regressions in that chapter control for the degree of democracy, but most importantly because the model presented is applicable only in democracies. I assume a benevolent government that maximises the individuals' utilities. Although 'benevolent government' and 'democratic government' are not synonyms, in general one can expect a democratic government to be more interested in maximising the social well-being than a dictatorial government, which may have a separate agenda. In particular, the government in chapter 2 is aware of each individual's utility function, which includes altruism. When the optimal subsidy rate is found, individual altruism is taken into account, which can only be done by a government that is aware of and internalises individuals' values and preferences. This is a characteristic of democratic governments. Additionally, in the model of that chapter the government sets the subsidy rate that maximises the utility function of infinite future generations, meaning that the government cares about the very long run. As I argue later in this chapter, this is a characteristic of democratic governments, while we can expect dictatorships to be more short-sighted. When I incorporate a totally short sighted government in the model of chapter 2, the result is an optimal subsidy rate equal to zero, meaning no public subsidies to education.

Also, chapter 2 opens new questions for future research and hypothesises on the relationships between altruism, subsidies to education and democracy. If the relationship between altruism and democracy is in the direction pointed by some of the preliminary results presented in the chapter (which is in line with the conclusions of previous research, see Kolm 2006), then altruism could be a powerful non-economic factor driving the democracy-education link. The lack of historical data prevents the testing of this, but the question is highly relevant.

The 'piracy' argument: institutions and economic growth

To explain the possible causes of the apparent micro-macro paradox to which I referred above, Pritchett (1996 and 2001) claims that one of the reasons why the impact of education on growth has been below expectations is that the institutional and governance environment of some countries is perverse enough to distort the effects of education on growth. He argues that a bad institutional environment favours the application of new skills to activities that are privately remunerative but socially wasteful. Using North's (1990) expression, Pritchett claims that education can create better educated 'pirates' (Pritchett 2001 page 387). By 'piracy', he means activities that increase the personal income of someone at the cost of someone else, without increasing total output.⁵ Rodrik (2000) also argues that in the absence of adequate institutions, incentives would generate perverse results or not work at all.

This idea has been supported by other authors (see for instance Temple 2001) and is consistent with the evidence of 'sheepskin effects' (Jaeger and Page 1996) and the 'signalling' models to explain wages (see for example Weiss 1995), according to which, in some cases, diplomas and university degrees are more successful in increasing the bearer's wage than their actual productivity.

What are the conditions that minimize the risk of educating pirates instead of educating individuals whose increased productivity will legitimately promote growth and create positive externalities to other individuals? In other words, how does education become a positive input for

⁵ Examples would be a person that applies her education to hack software, or copy and sell copyrighted movies, or someone that uses her great knowledge of the tax system to find ways to cheat and evade.

growth instead of a fuel for piracy? These questions are not directly addressed in the literature, but there are clues to unveil a possible answer.

A lead is given by Bosworth and Collins (2003), which I discussed above. Analysing the effects of education on growth, they observe that the coefficient on educational quality is not robust to the inclusion of a measure of the quality of the government institutions. Their interpretation is that educational quality is just a proxy for the broader concept of the quality of governing institutions. More recently, Hanushek and Woessmann (2008) conclude that *“the macroeconomic effect of education depends on other complementary growth-enhancing policies and institutions”* (Hanushek and Woessmann 2008, page 648). This fits Pritchett’s idea (above) that the institutional and governance environment of some countries is perverse enough to distort the effects of education on growth. Putting both arguments together, the question that arises is how the institutional characteristics of a country influence the impact of education on growth. This question is high on the research agenda of the political economy of education (*“cross national [...] data allows the exploration of the impact on returns to schooling (or the gap between private and social returns) of differences in economic environments. This last question has been and seems a promising line for future research”*, Pritchett 2004, page 1). Other researchers also put this issue on top of the research agenda: after Temple’s (2001) failure to find clear connections between increased education and economic growth, he concludes that *“A perhaps more interesting task for future research is to explore the fine details of the institutional and incentive structure that best allocates a fixed amount of educational expenditure. [This question has] an immediate connection to policy, and the need for future research in this area is apparent more than ever”* (Temple 2001, page 917).

The idea that institutions directly affect growth is not new and there is some debate around it, fed by the failure of previous research studies to arrive at clear conclusions. For instance, Barro and Lee (1994) introduce measures of

civil liberties and political rights in their growth regressions and find puzzling results⁶, explicitly stating that this is an open area of research.

Bosworth and Collins (2003) use measures of institutional quality from 1982, introducing them as regressors in their growth regressions for two periods: 1960-1980 and 1980-2000. The institutional quality in 1982 performs better as a regressor for the growth in 1980-2000 than in 1960-1980, which Bosworth and Collins (2003) interpret as evidence that causation runs primarily from institutional quality to growth rather than the converse.

Acemoglu, Johnson and Robinson (2001) try to estimate the effect of institutions on economic performance. They acknowledge the problem that political institutions and economic performance reinforce each other through time and that mutual causation operates throughout history, which is precisely what makes the effect of one on the other difficult to measure. To avoid this problem, the authors use instrumental variables. This methodology looks for sources of variation of the 'independent variable' (institutional setup) that are not due to variations in the 'dependent variable' (economic performance). This allows for the measurement of the portion of the effect of the independent variable on the dependent that is not due to reverse causation. The instrumental variable they use is 'mortality of colonisers' as a source of variation of current institutions.

The argument is that during colonisation, the environments of the different regions of the world posed different health threats to colonisers. Therefore, the different mortality rates of the colonisers in the different

⁶ Barro and Lee (1994) introduce a measure of political rights and a measure of civil liberties in their growth regressions. Though both variables are highly correlated, the authors observe that they enter with opposite signs in their regressions: while the civil liberties variable has a significantly positive coefficient, the political rights variable has a significantly negative coefficient. The authors say that "*it is unclear what effects are picked up in the sample by the differential between political rights and civil liberties*", so "*we therefore claim only that the results on political freedom and civil liberties are an interesting topic for further research*" (Barro and Lee 1994, page 25).

territories affected whether they wanted to settle or not in some of those territories. In turn, whether the colonisers wanted to settle or not in a territory affected which kind of institutions they established to govern each region (institutions that were favourable or detrimental to economic progress). That initial setting persisted through inertia across time and affected the current institutions, which, in turn, affect current economic performance. Therefore, the authors estimate the effect of the mortality rate of colonisers on current institutions, and *that fragment* of the current institutions is known not to be caused by the current economic performance (reverse causation is avoided). With this methodology, the authors find strong effects of institutions on economic performance, which is robust to controlling for latitude, climate, current disease environment, natural resources, religion, current racial composition and other variables. These results hold when the institutions observed are related to property rights (economic institutions) but also when the institutions observed are political and related to the openness of the political participation.

Acemoglu, Johnson and Robinson (2002) provide further evidence of how institutions affect economic performance. They argue that among the regions colonised by European countries during the past 500 years, those that were initially relatively rich are now relatively poor, and vice-versa. They suggest this is the result of European intervention generating an ‘institutional reversal’ in those regions. Their explanation is that Europeans introduced institutions that were investment-friendly in regions that were previously poor, while in regions that were previously rich it was more profitable to introduce extractive institutions.

In consequence, during the eighteenth and early nineteenth centuries the countries with the most favourable institutions took the opportunity to industrialise. They overtook the previously relatively richer countries, which were used as sources of extraction, but were left with institutions that were not favourable for investment and economic growth. In this context, extractive

institutions mean a concentration of political power in the hands of a few (elite) that can expropriate the goods and the labour (slavery) of a majority. Therefore, in the societies where a small ruling elite had a strong interest in keeping the established relations of power and exploitation, there were little or no incentives to introduce changes (like industrialisation) that could affect the establishment and give power to other individuals. Indeed, industrialisation required “*the participation of a broad cross section of the society - the smallholders, the middle class, and the entrepreneurs*” (page 1279). In this way, again, the reversal of economic ‘fortune’ is explained by institutional factors.

Some scholars have found that the causation works in the other way, from growth to the institutions of government. Lipset (1960) claims that increased income generates favourable conditions for democracy because (i) a higher income means fewer distributive conflicts, so that less pressure on the democratic system makes it less vulnerable; (ii) a higher income favours the strengthening of the middle class. Given that the middle classes tend to soften conflicts and generate a perception of equality, democracy is favoured; (iii) a higher income means more supply and demand of education. More educated societies are in a better position to form citizens that are tolerant, responsible and equal, essential values to form a democratic society; (iv) a higher income increases the propensity to participate in private organisations. Those organisations form, regulate and soften opinions, and also organise opposition. These processes are also healthy for democracy.

Glaeser et al (2004) agree with the direction of causality suggested by Lipset (1960). They start by arguing that the traditional measures of institutions are not appropriate, because they do not measure real constraints on the political power, and they are too volatile (they expect institutions to be more stable over time). In contrast, the authors claim that measures of

democracy like that of Polity IV⁷ measure an institutional outcome, rather than an institution itself. For that reason, these variables cannot be used to establish causalities between institutions and economic growth. Therefore, the authors run (static OLS) regressions of economic growth over 1960-2000 on some proposed institutional measures (measures that, according to the authors, do a better job at capturing stable constraints of the government): executive constraints, expropriation risks, autocracy, government effectiveness, judicial independence, constitutional review, plurality and proportional representation. They find that these 'more appropriate' measures of institutions do not have a significant explanatory power over economic growth. Also, once the 'appropriate' variables for institutions are included, the initial level of average years of schooling becomes significant explaining subsequent growth. From this, the authors conclude that the traditional (and inappropriate) measures of institutions are correlated with economic growth because of reverse causality: education is good for growth, and with higher income, they can afford democracy.

Glaeser et al (2004) also discuss what they understand are the pitfalls of Acemoglu, Johnson and Robinson's (2001) selection of instrument (presented above). Among other issues, Glaeser et al (2004) claim that the instrument chosen by Acemoglu, Johnson and Robinson (2001) is incorrect, as it may be picking up the effect of human capital: colonisers may have brought with them institutions, but they certainly brought their human capital. In this case, the instrument chosen becomes invalid, because valid instruments must be uncorrelated with the error term: if the pattern of settlement affects growth through channels other than institutions, then they are not valid instruments.

⁷ Polity IV is a dataset provided by the University of Maryland, that contains data on regime authority characteristics for a large set of countries from the year 1800 onwards. In particular, the dataset contains a widely used measure of democracy (variable 'Polity', which measures the degree of institutionalised democracy from -10 to 10, with higher numbers representing more democratic countries).

Yi Feng (1997) argues that the positive effect of democracy on growth is not direct, but there is an indirect channel: democracy promotes political stability, which in turn is good for growth. With a model of simultaneous equations and using three-stage least-squares estimations, Yi Feng concludes that democracy promotes growth indirectly by inducing regular government changes and inhibiting political instability. Also, he finds that although in the short run the effect of growth on democracy may be ambiguous, in the long run it is positive, which explains the contradictory results in the literature.

Barro (1999) observes over 100 countries from 1960 to 1995 and finds that higher per capita GDP increases the level of democracy, being measured by the level of electoral rights or by the level of civil liberties. Among other controls, he uses a variable that accounts for colonial history: he uses a dummy for former colony/non-colony and also introduces a breakdown among British, French, Spanish and Portuguese colonies. In both cases he finds that those dummies do not account for different levels of democracy, though he hypothesises that former colonial status may influence democracy indirectly through effects on the level of income. If this is put together with Acemoglu, Johnson and Robinson (2001) (discussed above), the joint hypothesis would be that previous colonial history has an effect on the later standard of living, which in turn affects the level of democracy.

Pinto and Timmons (2005) conclude that democracy affects *how* countries grow rather than *how much* they grow. Using time series for a panel of 44 to 91 developed and developing countries over 20 to 38 years (depending on data availability for different regressions), they conclude that political competition lowers the rate of factor mobilisation⁸ but increases the rate of human capital accumulation and productivity. First, democracies

⁸ Factor mobilisation refers to physical capital accumulation. They expect that “Countries with higher scores on the political competition index will have lower levels of capital formation relative to gross domestic product (GDP)” (Pinto and Timmons 2005, page 35).

should have a negative effect on investment levels for two reasons: (i) if the income of the median voter is below the mean, she will push for redistribution, which would discourage investment from the rich. On the other hand, if only the rich could vote (nondemocratic elite), the probability of redistributing the investment proceedings decrease, which provides more incentives for investment; (ii) political competition could affect fiscal and monetary policies, originating political business cycles that undermine incentives to invest. According to the authors, “*in the face of highly competitive elections, politicians have incentives to forsake long-term stewardship for short-term exigencies, promoting fiscal and monetary extravagance*” (Pinto and Timmons 2005, page 22).

Second, democracy could have a similar effect on labour supply: whereas democracies have to rely on consent, less democratic regimes can use coercion, repressing labour organisations and mobilising labour by direction. These first two points are shared by Krugman (1994), who compares the experience of the East Asian ‘miracle’ countries in 1966-1994 with that of the Soviet Union in the nineteen-fifties, and concludes that in both cases growth was a result of a massive increase in inputs rather than in return per unit of expenditure. Krugman argues that in the case of the Soviet Union, the authoritarian regime allowed an unprecedented ability to mobilise great amounts of physical and human resources, making growth the result of a quantity effect.

Third, Pinto and Timmons (2005) claim that in democracy, the median voter would push for the provision of public goods, especially education, raising the level of human capital and increasing the long-run growth. This is consistent with Saint-Paul and Verdier (1993), which is discussed below.

Fourth, the authors claim that democracies are more likely to see productivity gains for two reasons: (i) politically competitive regimes allow for the best ideas to move freely and filter through the economic and political

system, eventually turning into policies and products⁹; and (ii) more competitive regimes are more likely to remove sources of rents and encourage the efficient use of resources.

Pinto and Timmons (2005) claim that all these factors affect how countries grow rather than how much they grow. Quinn and Woolley (2001) point in a similar direction when they conclude that democracy does not affect the rate of growth, but the stability of growth (democracies tend to have more stable rates of growth).

The literature does not limit the economic effects of democracy only to growth. Among other effects, scholars have been debating the effects of democracy on budget allocations (see for example Mulligan, Gil and Sala-i-Martin 2004; this is discussed in chapter 3), on the quality of policy outputs (Lake and Baum 2001) and on income inequality (Acemoglu and Robinson 2006). However, no previous research directly explains how democracy intervenes in the impact of education on growth.

Education and democracy

I have shown that the relationship between democracy and growth does not bring consensus between scholars, and that establishing links between education and growth has brought discrepancies. The relationship between democracy and education does not bring a full consensus either:

⁹ This point is related to Lucas' (1988) idea that human capital has strong 'external' effects (positive externalities) when individuals interact with each other: he claims that the positive externalities of human capital have to do with "[the] influences people have on the productivity of others, so the scope of such effects must have to do with the ways various groups of people interact, which may be affected by political boundaries" (Lucas 1988, page 37). He goes a step further and claims that "human capital accumulation is a social activity, involving groups of people" (Lucas 1988, page 19). Therefore, if individuals are left to interact and exchange ideas freely (something that is a characteristic of democratic regimes), these positive 'external' effects could be enhanced.

some authors claim that more education brings more democracy (for example, Barro 1999, Glaser et al 2004, Glaeser, Ponzetto and Shleifer 2006, Benavot 1996), others claim that it is democracy that brings more education (Baum and Lake 2003, Stasavage 2005). Yet others reject the hypothesis that education makes democracy more likely (Acemoglu, Johnson, Robinson and Yared 2004), and others claim that it is the distribution of education (and not the average years of schooling) that makes democracy thrive (Castelló-Climent 2008). Some of these pieces of research are commented upon below.

Barro's (1999) research on the determinants of democracy was discussed above for the relationship between income and democracy. In his regressions he also finds that an additional year of average school attainment raises his electoral rights indicator by 0.01 in the short run and 0.04 in the long run (the electoral rights indicator that he uses ranges from 0 to 1, where a higher value means more rights).

Glaeser et al (2004) was already discussed above, when I referred to the relationship between democracy and growth. However, it is also worth mentioning that the authors refer to the relationship between education and institutions. Trying to find a relationship between these two factors, the authors regress growth in years of schooling (using five-year intervals between 1960 and 2000) on country fixed effects, initial schooling, initial level of GDP per capita and several measures of political institutions (executive constraints, expropriation risks, autocracy, government effectiveness, judicial independence, constitutional review, plurality and proportional representation). They find that political institutions have no effect on the growth of schooling. Additionally, they regress the changes in political institutions over five-year periods on country fixed effects, initial schooling, initial level of economic development and initial levels of the political institutions. They find that initial levels of schooling are a strong predictor of changes in institutions, even after using different measures of institutions.

Glaeser, Ponzetto and Shleifer (2006) argue in the same direction. They assume that while democracy requires the support of a broad base of citizens who face weak incentives to fight for democracy, dictatorship offers much stronger incentives to fewer supporters. Critically, they assume that education raises the benefits of political participation, so that when more people receive education, they have stronger incentives to fight for it, increasing the probability of a transition to democracy and increasing the stability of democracy once it has been established. I discuss more features of this paper in the next section.

Baum and Lake (2003) claim that democracy has a positive impact on growth through its effect on female secondary enrolment rates. They find that the level of democracy has a significant (and contemporaneous) effect on female secondary enrolment, which in turn has a positive effect on growth (whereas their results show that democracy has an insignificant direct effect on economic growth). This paper is discussed in more detail below, when I refer to the interaction between education, democracy and growth.

Acemoglu, Johnson, Robinson and Yared (2004) assess Glaeser et al (2004). They argue that the results of Glaeser et al (2004) are driven mainly by a cross-country correlation between education and democracy rather than by variations within countries. They argue that if there was a link between education and democracy, a link between changes in education and changes in democracy should be evident, and they show that it is not (see figure 2 in their paper). They conclude that this is an indication that the cross-country correlation between education and democracy is caused by some common omitted factors affecting both education and democracy (which they argue is behind the results of Glaeser et al 2004). When Acemoglu, Johnson, Robinson and Yared (2004) estimate a dynamic panel data model controlling for country specific effects and analyse the relationship between education and democracy within countries (they use first-difference Generalised Method of Moments

(GMM) estimation, discussed in more detail in chapter 4), they find no relationship between the increase of one and the increase of the other.

Castelló-Climent (2008) assesses Acemoglu, Johnson, Robinson and Yared (2004), and concludes that their results are biased due to the use of first-difference GMM estimation in the presence of persistence in the explanatory variables (this is discussed in more detail in chapter 4). To solve this problem, she uses system-GMM estimation (this is the estimation method used in chapter 4 in this thesis) and concludes that even when controlling for fixed omitted variables, more education is related to more democracy. But her main result is that the distribution of education (measured by the percentage of education attained by sixty per cent – the third quintile - of the population) is the relevant educational variable determining democracy. Bobba and Coviello (2007) also point to the same weakness of Acemoglu, Johnson, Robinson and Yared's (2004) results, re-estimate them using system-GMM, and also conclude that the lack of education-democracy link was due to a bias produced by the use of first-difference GMM estimation rather than system-GMM.

Education, democracy and growth: a possible interaction

The findings of Pritchett (1996, 2001) and Bosworth and Collins (2003) mentioned above could be consistent with the existence of a mediating effect of democracy in the education-growth link. Persson and Tabellini (1994) use political institutions to explain the impact of inequality on growth: instead of directly regressing growth on inequality, they use interaction terms between political institutions and inequality, and conclude that a negative link between inequality and growth is only present in democracies, because it is only in that political environment that the poor can press for redistribution. If this were the case, then, in a democratic environment, more equal societies should grow faster.

Saint-Paul and Verdier (1993) reach a conclusion opposed to that of Persson and Tabellini (1994) (although they do not provide empirical evidence, as Persson and Tabellini (1994) do). Using a non-overlapping generations model, Saint-Paul and Verdier (1993) conclude that in democracy inequality could be good for growth as long as that inequality provides more support for public education. On the other hand, if the poorest are excluded from the electoral process (which could be associated with a lack of democracy), the authors expect inequality to reduce the support for public education, which would have a negative impact on growth.

Until now, an analysis similar to that of Persson and Tabellini (1994) has not been performed to explain the relationship between education and growth; in other words, the question of whether the effect of education on growth is altered by the political freedom has not been answered.

The theoretical background and models provided by Bourguignon and Verdier (2000) and Glaeser, Ponzetto and Shleifer (2006), as well as the theory, models and historical evidence exposed by Acemoglu (2003), Acemoglu and Robinson (2000, 2002 and 2006) and Robinson (1999) provide a comprehensive explanation for how democracy and education may have evolved together across time. They state that dictators find a trade-off when they have to decide whether to provide education or not. If they educate the population, the economy can grow faster and they can benefit from that growth (for example, through the extraction of more resources). But at the same time, a more educated and richer population poses a bigger threat to the ruling dictator.

Bourguignon and Verdier (2000) present a model in which education raises political participation (they assume that only the educated can vote) and generates positive externalities to the wider economy. The uneducated have lower incomes and do not vote, whereas the educated are richer and do vote. The rich can choose to keep the poor uneducated and maintain their monopoly

of the political decisions, or can choose to make the necessary transfers to educate the poor and benefit from the externalities, but at the same time share the political rights with the newly educated. With this second option, the rich also risk that the newly educated (who may still earn less than the average income after receiving education) may vote for more redistribution, which may be against the interest of the rich. Further below I comment on additional features of Bourguignon and Verdier (2000).

Glaeser, Ponzetto and Shleifer (2006) provide some empirical evidence indicating that education promotes democracy, and ask why a dictator would choose to provide education knowing that doing so is against the survival of their regime. They propose three possible answers: (i) many dictators face external threats, so they need to grow their economies and their armies even if this increases the chances of democratization; (ii) dictators can derive personal benefits from economic growth, and therefore promote education to get richer; (iii) all dictators face ouster risks, and it is much better for the dictator's safety to be replaced by a democracy in an educated country rather than by a new dictatorship in an uneducated one.

Acemoglu and Robinson (2000, 2006) claim that at first the dictator can offer some small transfers and benefits to the masses (like public education) in order to keep them satisfied and under control. But transfers can be instated and later removed, according to the will of the dictator and to the threats he perceives, so the population knows that public education can be transitorily provided to the masses as a way to avoid revolutions. During periods of acute unrest and when people can overcome the collective action costs (for example, because education could bring the collective action costs down), the power of the dictator is challenged beyond the limits that transitory concessions and transfers can reach. In those situations, the authors claim that the most cost-effective option for the dictator is to transfer more than money: when the dictator transfers political power to the masses, he is showing a real commitment to long-run transfers. This is because when the dictator transfers

power, he is limiting his capacity to stop specific transfers and benefits in the future.

In this way, the extension of the franchise (the transfer of political power from the dictator to the masses) is a strategy that the dictator can use to avoid revolutions against him. This allows the dictator to cede power slowly (giving away power thus extending democracy) rather than cling to power and risk losing everything violently because his transfers are not sufficient to stop a revolution. Finally, the newly enfranchised population may use democracy to tilt economic institutions and the income distribution in their favour, for instance, through extending public education.

Introduction to Chapter 3

Chapter 3 in this thesis builds around these concepts: a dictator has limited resources, which he can use to educate people (raising general income and thus his proportional tax revenue) or to recruit more soldiers and make his dictatorial regime less likely to be overthrown. Previous research referred to this budgetary trade-off and concluded that dictatorships tend to spend more in the military than democracies (Lebovic 2001, Mulligan, Gil and Sala-i-Martin 2004, Habibi 1994; these papers are discussed in chapter 3). In the case of chapter 3, the trade-off is used to set up a model of political transitions, and is put under more strain when educated individuals offer transfers to uneducated individuals to persuade them not to join the army, with important implications in terms of income distribution. As the chapter shows, the potential effects of education on income have a crucial role to play in the amount of transfers observed in society (and thus in the distribution of income) and on the transitions to and from democracy.

A critical difference of chapter 3 with Bourguignon and Verdier (2000) is that they put the decision to extend the political rights in the hands of the

elite (in this case, the dictator): in their model the elite decide whether to provide public education (the poor are liquidity-constrained and cannot afford education by themselves), and they also assume that only the educated have political rights. In terms of the relationship between education and democracy, this amounts to assuming causality from education to democracy. Therefore, when the elite decide to extend public education, they are also deciding to share power with the newly educated. However, the elite may decide to do this because they benefit from the positive externalities of a more educated population, so they have to compare the benefits they obtain from the positive externalities with two sets of costs: directly, the costs of the transfers needed to educate the poor; indirectly, the costs associated with the probability that once educated, the newly enfranchised individuals may vote for more transfers from the rich to the poor. Faced with these benefits and costs, the elite may decide to educate only a number of poor that will not change the voting majority, so that the elite maintain the political power but at the same time can benefit from the educational externalities. This favours the appearance of the middle class, and at the same time reduces the growth rate that would be observable if all the poor received education.

In contrast, the model of chapter 3 allows for transitions to democracy to either be caused by the dictator himself or promoted from the citizenry. This, I believe, provides a more realistic approach. Additionally, in the model of chapter 3, one of the critical factors that limit the ability of the dictator to maintain democracy has to do with the effect that education expenditure has on income: the greater the effect of education expenditure on income, the more difficult it is for the dictator to maintain dictatorship. This, to the best of my knowledge, has not been incorporated before.

The same difference applies with Acemoglu and Robinson (2006), who also put the final decision to democratise in the hands of the dictator. They assume that repression always succeeds, so the dictator can always deter democratising threats through repression. Ultimately, the dictator compares

the costs and benefits of repression and democracy and then decides which to choose.

The model of Acemoglu and Robinson (2006) is oriented in a different way to the model presented in chapter 3: for example, they observe the effect of income distribution on the transitions to democracy, which is something I do not do in this model. The model presented in chapter 3 of this thesis does not assume that educated individuals earn more than soldiers or informal workers. This differs from Acemoglu and Robinson (2006), who assume that there are 'rich' and 'poor' individuals, and that the rich are the 'ruling elite' and the poor are the citizenry. So while I assume that there is only one dictator and that the citizenry is divided between educated and non-educated (with potentially different levels of income between those two groups), Acemoglu and Robinson (2006) assume that there is a 'ruling elite' with a level of income higher than that of the rest of the citizens (who all earn the same). However, the most important difference between this model and that of Acemoglu and Robinson (2006) is that in their case, income does not depend on education expenditure, whereas in this model, education expenditure has a central role (and is the determinant of the level of income of the educated population).

One of the features incorporated by Acemoglu and Robinson (2006) is what they call the 'cost of revolution' (μ in their model), which reflects the fraction of total income that is lost in a democratising revolution due to the economic disruption generated. The citizenry, before starting a revolution, compare that cost of the revolution with the benefits they can obtain (the share of income that during a dictatorship is held by the ruling elite, represented by θ in their model). In the model of this chapter, the concept of μ is partly reflected in the level of transfers T , as they represent the cost that has to be paid (by the educated individuals) to obtain democracy. On the other hand, the benefits of democracy (the θ of Acemoglu and Robinson 2006) are in chapter 3 derived from two different factors: (i) the cessation of the dictatorial taxes

paid by the educated individuals during dictatorship (having them removed in democracy is a benefit for them); and (ii) the increase in income during democracy that results from more resources being directed to education. Also, other benefits of democracy include the transfers that some non-educated individuals receive from the educated individuals, though those transfers are not seen as benefits by those who ultimately promote the transition to democracy (the educated individuals, who promote the transitions, do not see the benefits of the transfers received by the non-educated; on the contrary, those transfers are costs for educated individuals).

Eight possible interaction channels

None of the work mentioned above analyses how the interaction between education and democracy affects growth. Here, I present eight channels through which the institutional and governance environment of dictatorships can weaken the expected education-growth relationship.

Firstly, in a non-democracy the ruling elite can divert expenditure in education to favour themselves, subsidising, for instance, higher-level education even in contexts of high illiteracy. This is still education expenditure, but at the same time it reinforces the power of the elite, which may then become even more powerful to introduce distortions that prevent further growth.

Second, although corruption is present in both democracies and non-democracies, the accountability of a democratic system is (at least theoretically) higher than that of a dictatorship (see for example Lederman, Loayza and Soares 2005 or Aghion, Alessina and Trebbi 2007, discussed below), making diversion of educational funds less feasible in a democracy. There is evidence that in some countries a large share of government spending in education is not actually going to education, and that there are huge

problems with issues such as teacher absence (see for example Chaudhury, Hammer, Kremer, Muralidharan, and Rogers 2006 or Duflo and Hanna 2005).

Third, a dictator may expropriate goods or generate a feeling of lawlessness that inhibits the capacity of education to promote growth (Dixit 2004, among many others). For instance, if property rights are at risk because the dictator can expropriate arbitrarily, private investment becomes less attractive, so the possibilities for educated people to contribute to the economy are reduced. An extension of this point is that of Pritchett's (2001) 'piracy'. Similarly, this kind of environment is favourable to information asymmetries, which can intensify the 'signalling' and 'sheepskin' effects mentioned above.

Fourth, Acemoglu and Robinson (2006) argue that in dictatorial regimes, the burden of repression or coups often falls on the individuals who are killed during conflict. This makes it difficult for dictatorships to take full advantage of the education embodied in individuals.

Fifth, dictatorial countries tend to exile or expel part of the population, which seeks asylum abroad. Again, this makes it difficult for dictatorships to take full advantage of the education embodied in individuals. But additionally, educated people may find it easier to leave the country and start a new life abroad, and may be more likely to do so if they face the risk of political repression. In this case, the investment in education that is embedded in them may not promote growth.

Sixth, according to Sylwester (2000), governments with different time horizons perceive different benefits and costs from educational expenditure. If governments with longer time horizons perceive more benefits from spending money in education than governments with shorter horizons, a relevant issue to observe is whether dictators have shorter time horizons than democratically elected governments. At this point I cannot answer this question, but some reasonable assumptions can be made: dictators usually face a constant threat

of being overthrown; they will not need to face re-election; they do not necessarily belong to a party that needs to build reputation; and they do not necessarily benefit from the well being of future generations (while the citizenry may benefit from this, and so their democratically elected government). All this suggests that dictators have shorter time-horizons (or higher discount rates) than democracies. In this case, I do not only expect that dictators will spend less in education, but also that they may spend differently, promoting expenditures in education that maximize immediate visibility of the government, but not necessarily growth in the long-run.

Seventh, as noted by Lott (1990, 1999), totalitarian governments can use public education to spread indoctrination. Whereas a democratic government cannot avoid the plurality of views and ideas, a dictator can channel whatever religious, political or moral principles are convenient for his regime through a public educational system that allows no opposition. In this case, the educational expenditure devoted to spread indoctrination would not necessarily add to the productivity or level of skills of individuals, thus reducing the impact of that educational expenditure on economic growth.¹⁰

Eighth, some dictatorships tend to concentrate the decision power centrally at the expense of individual free choice (the centrally planned communist economies are an example of this). In this case, if individuals cannot choose their work freely, there is a chance of misallocation of talent which has negative implications for growth, meaning that the potential of the education embedded in individuals may not be fully realised (for the effects of the allocation of talent on growth, see for example Murphy, Shleifer and Vishny 1991).

Table 1 summarises the eight channels described above.

¹⁰ Glaeser, Ponzetto and Shleifer (2006) claim that in democracies education is also used to indoctrinate, though in that case the indoctrination is about the benefits of political participation.

Table 1

1	Dictator has the discretion to allocate education expenditure in ways that favour the ruling elite.
2	Corruption and lack of accountability favour diversion of education expenditure in dictatorship.
3	Dictator's unaccountable powers threaten rule of law and property rights, which discourages investment and damages growth.
4	In dictatorship, the burden of repression falls on individuals (and the education embedded in them).
5	Exile or persecution expels individuals (and the education embedded in them).
6	Different time horizons mean dictators may emphasise education expenditure with high short-run visibility but lower long-run impact.
7	Dictators may use education to spread indoctrination rather than productive skills.
8	Central power can be ineffective at allocating talent.

Introduction to Chapter 4

All these channels call for a consideration of the effect of democracy on growth through education, and of education on growth through democracy, instead of the traditional approach that presents both channels separately. These effects are considered in chapter 4: I test whether democracy is an intervening factor in the education-growth relationship, using interaction terms and different measures of education. If the interaction of democracy and education is relevant to explain economic growth, this means that education and democracy reinforce each other's effect on economic growth: To act as a proxy for 'education', I use an input of the education process (expenditure on education) and an output of the education process (average years of schooling). The econometric tool used is Arellano and Bover's (1995) and Blundell and Bond's (1998) system-GMM estimator.

Addressing this question will shed light on the relevance of education and political institutions to the growth process, and will also help to explain some of the divergence found in the literature. At the same time, the policy implications to be drawn are of paramount relevance: if democracy has indeed a role to play in the education-growth relationship, should not some countries (mainly poor ones) get the 'right institutions' before engaging in education spending?

Aghion, Alesina and Trebbi (2007) test whether the economy's proximity to the world technological frontier increases the positive effects of democracy on economic growth. They test this using interaction terms: they multiply their measure of proximity to the technological frontier by a measure of democracy, and find that the interaction is significant and negative, while the direct effect of democracy on growth is positive. This means that when countries are close to the technological frontier (so the distance decreases), the effect of democracy on growth is positive (the positive direct effect of democracy is greater than the interaction term, which may be zero if the country is in the technological frontier, or very small in absolute terms if the country is close to the frontier), while for countries that are far from the technological frontier, the negative interaction term overrides the positive direct effect of democracy, meaning that democracy becomes growth-diminishing. Although the effect of democracy on growth has been approached by other scholars before (see discussion above), Aghion, Alesina and Trebbi (2007) argue that the novelty of their contribution is that no one before has interacted democracy with the economy's proximity to the world technological frontier. The novelty of chapter 4 in this thesis is derived in the same way: though previous scholars have observed the effect of education and democracy on economic growth, no one has actually interacted both factors as I do in chapter 4.

As referred to above, Hanushek and Woessmann (2008) acknowledge that the effect of education on growth depends on other policies and

institutions, though they do not refer explicitly to democracy. They show that mapping for education through cognitive skills can account for three times the variation in economic growth of models that use years of schooling to map for education. Using data from different international student achievement tests (in literacy and numeracy), they build a measure of cognitive skills which outperforms years of schooling as an explanatory variable for economic growth. They conclude that this is due to the fact that including years of schooling in the growth regressions implies that a year of education produces the same increase in knowledge and skills regardless of the educational system, whereas the cognitive skills actually acquired by the population are a better indicator of the outcome of the education received. For example, differences in the quality of the education establishments or the educational systems of two countries can explain why two individuals with the same number of years of schooling may have different levels of productivity, and therefore have different impacts on economic growth.

A particularly relevant feature of Hanushek and Woessmann (2008) is that they use interaction terms between their measure of education and measures of the ‘appropriateness’ of institutions, which is methodologically similar to what I do in chapter 4 (in the sense that I also use interaction terms to measure the education-enhancing capabilities of institutions). This leads them to the conclusion that education not only impacts on growth directly, but also that better institutional quality increases the impact of education on growth, which is precisely what I test in chapter 4. However, there are a number of considerations to be made when comparing chapter 4 to Hanushek and Woessmann (2008).

First, Hanushek and Woessmann (2008) do not consider democracy as one of the institutions conducive to growth. Instead, they use trade openness and protection against expropriation. Though I do use trade openness as one of the possible explanatory factors of growth in chapter 4, my main institutional regressor (and the one I interact with education) is democracy. The next sub-

section explains why I believe that democracy may be a better measure of the appropriate institutional framework for education to have an impact on economic growth.

Second, data on cognitive skills, as measured by Hanushek and Woessmann (2008), are now available for only 77 countries (see Hanushek and Woessmann 2009). On average, the number of countries included in the regressions of Hanushek and Woessmann (2008) is less than half the number of countries included in the regressions of chapter 4 (additionally, the authors admit that their sample is biased towards developed economies). Even more limiting, the internationally comparable data on cognitive skills are in most cases available as one or two observations per country. In Hanushek and Woessman (2009), the closest that the authors get to a time series analysis is a observation of 15 (rich) countries with two data points (1975 and 2000). This makes it hard to assess whether changes of cognitive skills over time really have an impact on economic growth. The data available allow for the observation of cross sectional correlations between education and growth, rather than within variations (how changes in cognitive skills affect the rates of growth).

Third, the analysis of Hanushek and Woessmann (2008) compares a unique initial year with a unique final year, whereas that of the regressions included in chapter 4 uses time series including various years. The option to use time series is one of the benefits derived from the relative abundance of the data I use when compared to that used by Hanushek and Woessmann (2008).

These last two considerations were also identified by Barro and Sala-i-Martin (2004) when they conclude, after using a test-scores variable, that *“the overall indication is that the quality of education is far more important for economic outcomes than the years of schooling. Unfortunately, the limited*

amount of international data on test scores makes it difficult to go further with this analysis” (Barro and Sala-i-Martin 2004, page 537).

For this reason, the analysis in chapter 4 becomes all the more relevant: if educational quality is only a proxy for the quality of institutions (as argued by Bosworth and Collins 2003), then including measures of the governing institutions (like democracy) may be better than introducing measures of cognitive skills and arguing that those are the result of the mediating effect of educational quality on years of schooling. In other words, democracy may already include the relevant part of the ‘appropriate’ institutional environment, probably (as concluded by Bosworth and Collins 2003) doing a better job than the ‘educational quality’ that is supposedly embedded in the cognitive skills. Issues related to the availability of data also contribute against the use of cognitive skills, though this may change in the future if longer time series of cognitive skills become available.

All this means that it is necessary to make a case for the inclusion of democracy as the relevant institutional ‘enhancer’ of education.

A related (though not equal) approach is taken by Baum and Lake (2003). Their analysis has two steps. First, they estimate a regression of female school enrolment rate on democracy and some controls.¹¹ They find that democracy contemporaneously affects the female school enrolment rate. Second, they estimate a regression of GDP per capita growth on some controls, democracy and female secondary enrolment lagged 4 periods, and find that female secondary enrolment positively affects economic growth 4 periods later, while democracy has an insignificant (and negative) effect on economic growth.

¹¹ The authors focus on female school enrolment rates because they anticipate that these enrolment rates will be more sensitive to variations in regime type than those of men.

They interpret these results saying that democracy has no direct effect on economic growth, though it has an indirect effect through education: more democracy increases education (first regression), which in turn increases economic growth (second regression). To measure that indirect effect, the authors multiply the coefficient of democracy in the first regression by the coefficient of female secondary enrolment in the second regression. The indirect effect estimated in this way becomes positive and significant (at 10%) only for countries with a GDP per capita above US\$ 2500. However, this does not explain how democracy intervenes in the impact of education on growth; in this model the effect of education on growth is not affected by democracy. In turn, Baum and Lake's (2003) contribution is to provide a causal chain through which democracy may affect growth via a quantity effect: more democracy means more education (though the idea that democracy affects education contemporaneously is questionable), which some periods later is translated into more growth. All this also has the caveat that the results are only significant for countries above a certain threshold of GDP per capita, and that it is only tested for female secondary enrolment.

Education: error measurement in the education variables

A recurrent problem that appears in the literature when trying to assess the effects of education on economic growth is error in the measurement of education. This, according to some of the researchers, may account for the absence of an association between increases in educational attainment and economic growth.

Krueger and Lindahl (2001) compare the data on average years of schooling provided by Barro and Lee (1993) (henceforth 'Barro-Lee dataset') with that provided by Kyriacou (1991). Whereas Kyriacou's data (used among others by Benhabib and Spiegel (1994), discussed above) refer to the

education of the work force, the Barro-Lee dataset refers to the entire population of age 25 and older and of age 15 and older. According to Krueger and Lindahl (2001), Kyriacou (1991) derived his data as follows: first, estimates of the average years of schooling for 42 countries in the mid-1970s were regressed on the countries' primary, secondary and tertiary school enrolment rates. With the estimated coefficients, the author predicted the years of schooling from enrolment rates for all countries in 1965 and 1985. Krueger and Lindahl (2001) argue that this procedure can create substantial noise in the data, because the estimated regression may not hold for all the countries and time periods (plus enrolment rates tend to be mismeasured and the enrolment rates are not fully aligned with the workforce).

On the other hand, the Barro-Lee dataset is based on survey- and census-based estimates reported by UNESCO. From those initial values, the authors derived more observations from historical enrolment flow data using a 'perpetual inventory method' (Barro and Lee 1993). Krueger and Lindahl (2001) argue that the Barro-Lee dataset is superior to previous international measures of educational attainment, although errors in measurement are likely to persist because of the dubious quality of some of UNESCO's enrolment rates. By regressing one dataset on the other (the Barro-Lee dataset and Kyriacou's dataset) and observing relatively low correlations, Krueger and Lindahl (2001) conclude that an important portion of the measured change in the average years of schooling is non-informative. However, they conclude that to estimate the effect of educational improvements, the Barro-Lee dataset is preferable to that of Kyriacou.

Bosworth and Collins (2003) compare the Barro-Lee dataset with another dataset provided by Cohen and Soto (2001) (henceforth 'Cohen-Soto dataset'), who compute the educational attainment at the beginning of each decade for the period 1960-2000, where they assume that the educational attainment of a specific age cohort is constant in successive ten-year periods. Bosworth and Collins (2003) report that this dataset is highly correlated with

the Barro-Lee dataset, though the same is not true for the changes over time. The authors conclude that neither of these two approaches is convincingly better than the other, and that their divergences are evidence of the measurement error. For this reason, they choose to use a simple average of the Cohen-Soto and the Barro-Lee datasets.

Due to the debate on the measurement errors, Aghion, Meghir and Vandenbussche (2006) decide to present their results based on two datasets: they use the Barro-Lee dataset and a set of data provided by De la Fuente and Doménech (2002) (henceforth DD dataset). De la Fuente and Doménech (2002) report substantial changes in the classification criteria of educational attainment over successive censuses in many OECD countries, and present new estimations that adjust for those changes. A limitation of the DD dataset is that it covers only 21 OECD countries between 1960 and 1995 (the Barro-Lee dataset covers over 100 countries between 1960 and 2000).

Democracy as a meta-institution

Papers establishing relationships between democracy, education and growth typically refer explicitly to the contradictory background of mixed results. Given the relevance of the issues involved, instead of discouraging research, this should call for new approaches to the topic, which is precisely what I intend to do in this work. The eight channels mentioned above (table 1) illustrate how democracy could intervene in the education-growth relationship. However, it could be argued that some of the effects identified could be attributed to corruption, the lack of property rights (as argued by Hanushek and Woessmann (2008)), the absence of rule of law and serious law enforceability, and the violation of human rights, among other factors.

For instance, it can be said that it is corruption and not the lack of democracy that gives place to the first and second channels of table 1, or that

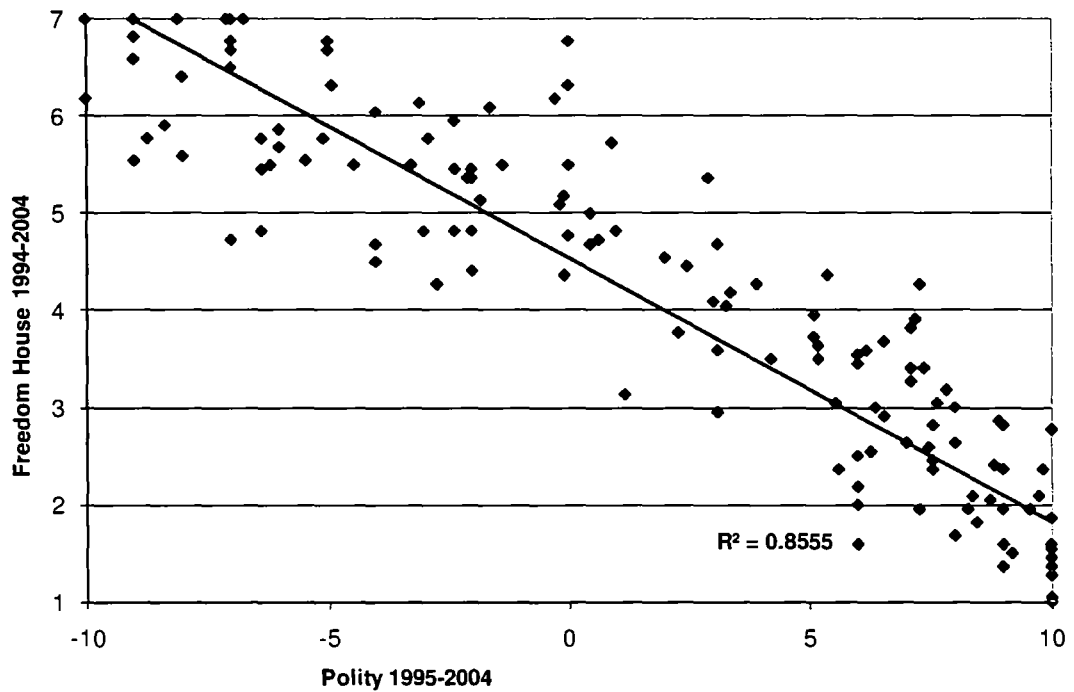
it is a weak property rights system and the absence of rule of law that generates the third channel. The violation of human rights could also explain the fourth and seventh channels. Why then do I focus on democracy?

There are several definitions of democracy, not only because the accepted view of what constitutes democracy changes over time (in general modern definitions tend to be more inclusive than previous ones), but also because different authors put minimum thresholds of democracy at different levels (different minimum conditions that need to be satisfied for a regime to be called 'democracy'). However, there are fewer measures of democracy, and the most extended of them are highly correlated with each other, as shown by figures 1 to 3.

Figure 1 shows two of the most widely used measures of democracy, averaged for the period 1994-2004 for a set of 157 countries. In the horizontal axis, the variable 'Polity' measures the degree of institutionalised democracy from -10 to 10 (where higher numbers mean more democracy), and is taken from the Polity IV database.¹² In the vertical axis, 'Freedom House' is an average of the Political Rights Index and the Civil Rights Index from the Freedom in the World Country Ratings (Freedom House, see www.freedomhouse.org). Both Freedom House indices range from 1 to 7, where lower numbers mean more freedom. As expected, figure 1 shows a strong negative correlation, given that Freedom House's measures decrease with democracy, while the Polity IV's measure increases with democracy. Appendix 1 presents a list of the countries included and descriptive statistics.

¹² Monty G. Marshall and Keith Jaggers. 2004; Polity IV Data Set [Computer file; version p4v2004]. College Park, MD: Center for International Development and Conflict Management, University of Maryland.

Figure 1



A new measure of democracy was introduced in 2006 by The Economist Intelligence Unit. This measure assigns scores from 1 to 10 to each country, where 10 is most democratic and 1 is least democratic. As this index became available in 2006 for the first time, there are no long time series for this index.

Figure 2 shows how this index correlates to Freedom House's index for the year 2006 for a set of 164 countries. Again, a strong consistency among both measures of democracies is found. Appendix 2 presents a list of the countries included and descriptive statistics.

Figure 2

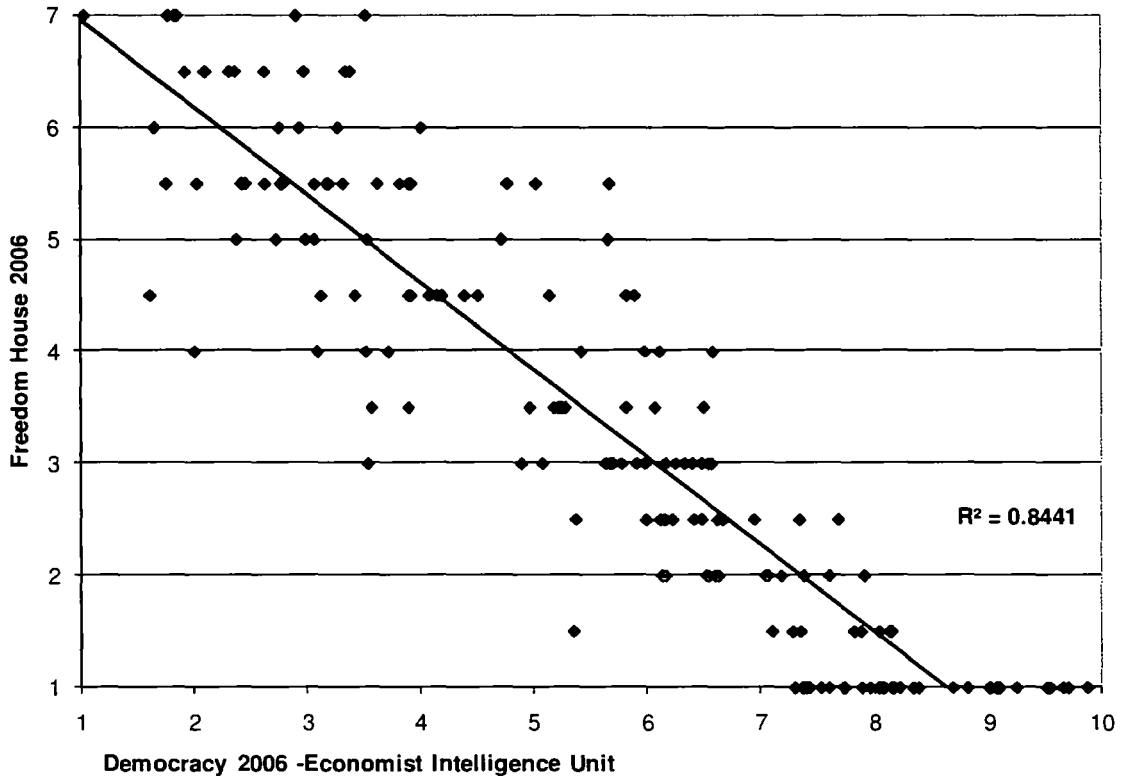
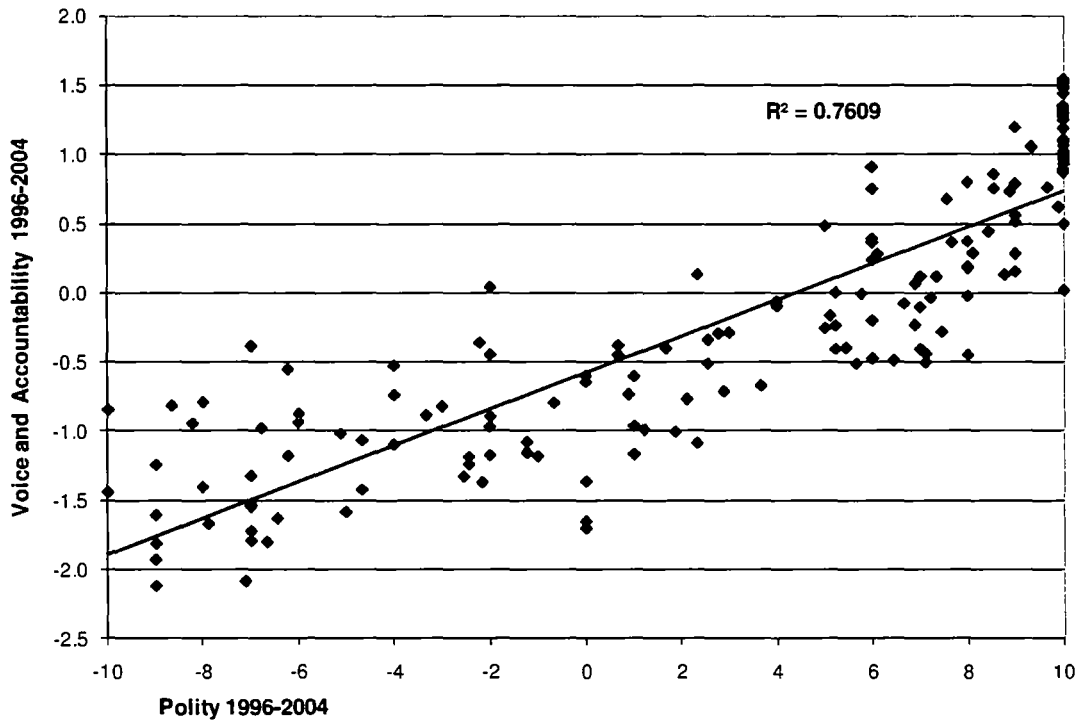


Figure 3 introduces a fourth measure of democracy ('Voice and Accountability') together with the 'Polity' variable, both averaged for 1996-2004 for a set of 160 countries. This variable comes from Kaufmann, Kraay and Mastruzzi (2006) and measures "the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media" (Kaufmann, Kraay, Mastruzzi 2006, page 4). Appendix 3 presents a list of the countries included and descriptive statistics.

Figure 3



But how does democracy relate to the other factors identified above (corruption, rule of law, law enforcement, property rights, human rights)? The determination of the causalities among these factors is beyond the scope of this thesis. However, the statistical evidence suggests that more democracy is correlated with more transparency (less corruption), better property rights, the presence of rule of law, better law enforcement, more respect for human rights, better regulatory quality, more political stability and more government effectiveness.

A well functioning democracy implies that all individuals should be treated equally before the law, and that this law has to be respected and enforced (property rights being just one of the rights guaranteed by the law); democracy also requires that individuals are free from oppression and repression (so their basic human rights should be respected); and that the

driving force behind the public sector procedures and the political sector's decisions is public well-being, and not the rent-seeking of politicians and/or bureaucrats (corruption). For these reasons, a well functioning democracy should set the institutional bases that guarantee the rule of law, human rights protection, transparency and law enforcement (which in turn is related to a better regulatory quality and more government effectiveness).

This is in line with the results found by Rigobon and Rodrik (2005), who conclude that *“Rule of law and democracy are generally mutually reinforcing and they tend to feed on each other”* (page 538). Perotti and Volpin (2006) observe the determinants of investor protection and entry across a set of countries, and conclude that investment protection is better in countries with more accountable political institutions. The World Bank (2006) insists that democracy and the control of corruption go hand in hand, suggesting that democracy is the causal factor in that relationship: *“when citizens can demand more accountability through the ballot box, or where there is freedom of expression, of the media, and of information, governments become cleaner and less corrupt”* (The World Bank 2006, page 7).

Aghion, Alesina and Trebbi (2007) test whether political rights (democracy) are more relevant for growth in countries that are closer to the technological frontier (discussed before). They claim that *“Bribes are certainly not unknown in democracies, but since they are more open, associated with more freedom of the press and involve alternation in power of different groups, democratic leaders are generally less likely to be permanently captured by incumbents”* (Aghion, Alesina and Trebbi 2007, page 10). This means that more democracy, which they claim increases transparency, competition and freedom of entry, increases the benefits of investing in new technology relative to those of bribing a policy maker to make them raise the barriers to entry. For this reason, they expect that democracy will increase the probability of entry of new firms in any given sector, which encourages innovation by advanced firms (which can innovate

and reduce the threat presented by new entrants) and discourages innovation in backward firms (which, being farther away from the technological frontier, fear that the value of any innovation may be destroyed by the new entrant). However, when Aghion, Alesina and Trebbi (2007) run their empirical tests, they find that a direct proxy for the probability of entry of a competitor ('procedures'¹³) does not perform as well as democracy, which leads them to conclude that the democracy variables "*capture something more general*" (page 18) than the direct proxy.

This is particularly important here: what is that 'something more general' that they refer to? The conclusions of the pieces of research presented above, together with the correlations in this section, indicate that democracy is associated with a 'cloud of factors' that generates a political and economic environment that may enhance the effect of certain factors on economic growth (particularly, that may be conducive to a stronger positive link between education and growth). Though it is difficult to associate empirically a cloud of (interrelated) factors with an observed phenomenon, democracy is useful for summarising that cloud of factors in order to explain the intervention of the political environment on the relationship between education and growth.

Rodrik (2000) also suggests that democracy could be the ultimate factor behind a set of appropriate 'growth-enhancing' institutions, describing democracy as a "*meta-institution for building good institutions*" (Rodrik 2000, page 5). Rodrik argues that there is a range of non-market institutions that perform regulatory, stabilising and legitimising functions that make a market economy work, and that well-functioning market economies mix state and market, laissez faire and intervention in different degrees, without a unique accepted level of one or the other. In turn, the best way to combine and adapt those institutional arrangements to the local needs and capabilities of

¹³ The direct proxy they use is the number of procedures needed to start up a business.

specific countries is through participatory political institutions. This means that democracy is a *meta-institution*, the institution that allows for the construction of other institutions better suited to local conditions, so that they enhance economic growth.

Theoretically, the eight channels mentioned above and summarised in table 1 show why democracy itself could be channelling education into growth. The previous research discussed above also points in this direction. Empirically, the next figures show how democracy is related to the other institutionally favourable preconditions of growth, indicating that it could at least be a good synthesiser of the ‘cloud’ of factors.

Figures 4 to 8 show how democracy is positively related to the factors mentioned above when using the same data set (Kaufmann, Kraay and Mastruzzi 2006). As previously explained, the variable ‘Voice and accountability’ is a proxy for democracy. All these figures represent a data set of 160 countries, and values are averaged for the period 1996-2005. Appendix 4 presents a list of the countries included and descriptive statistics.

Figure 4

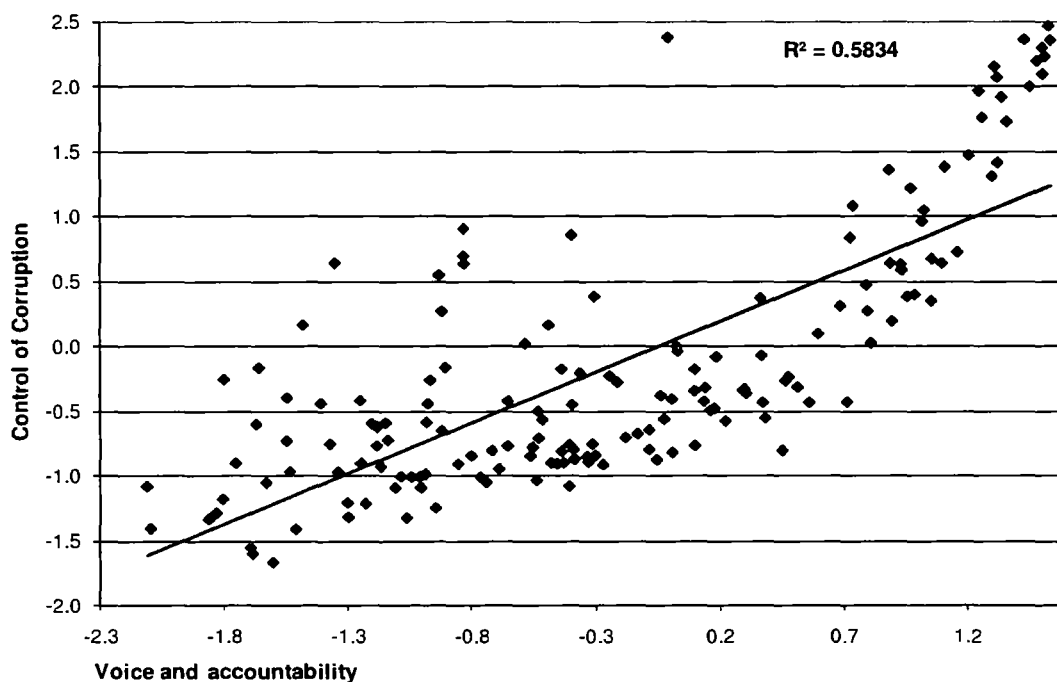


Figure 5

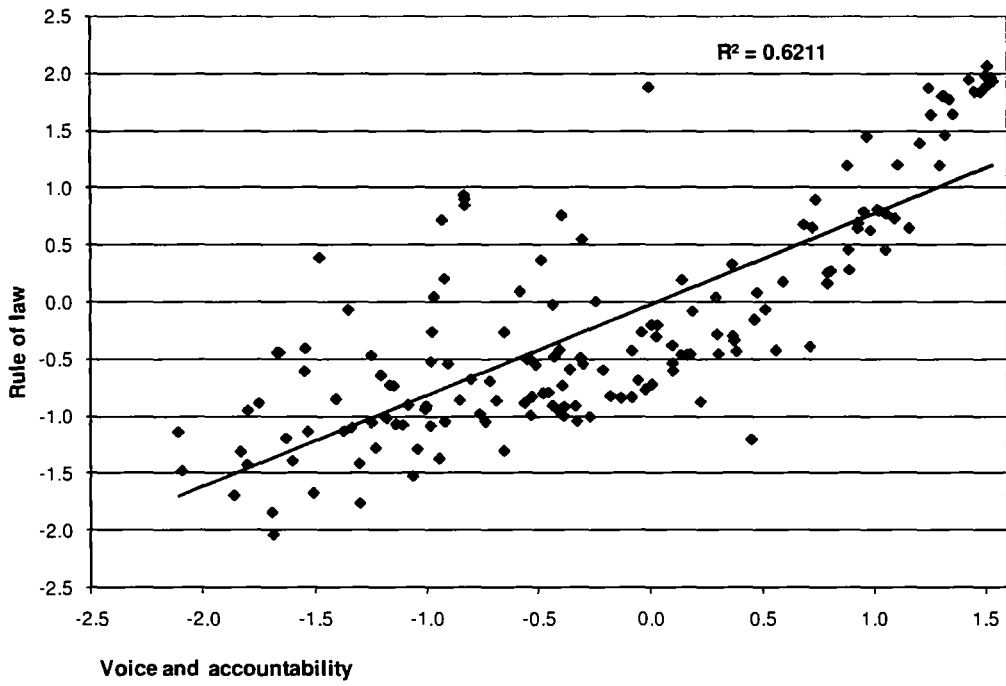


Figure 6

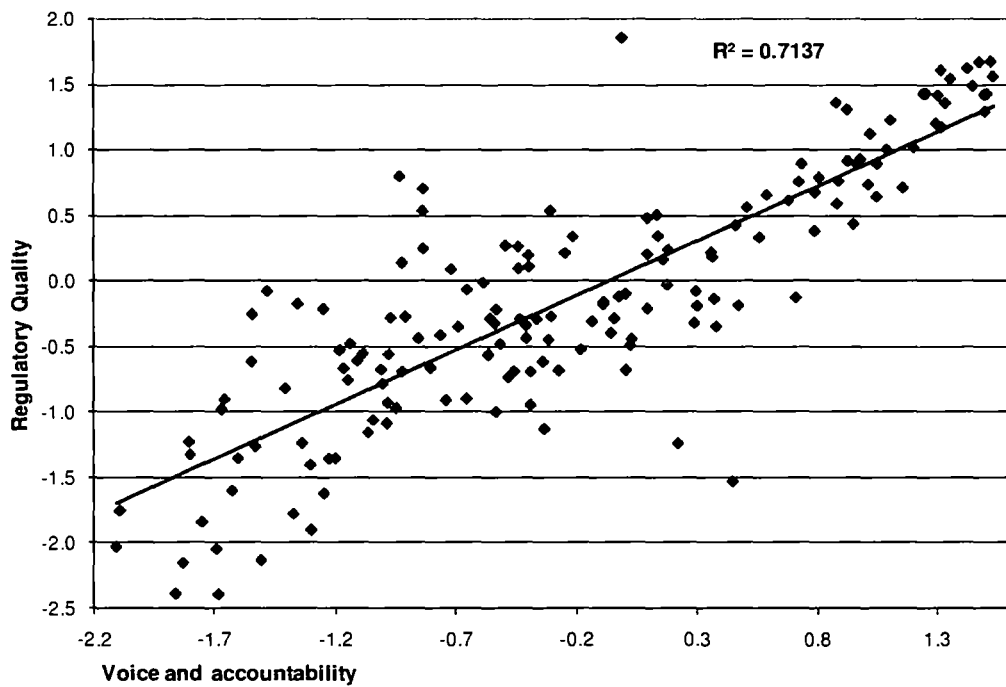


Figure 7

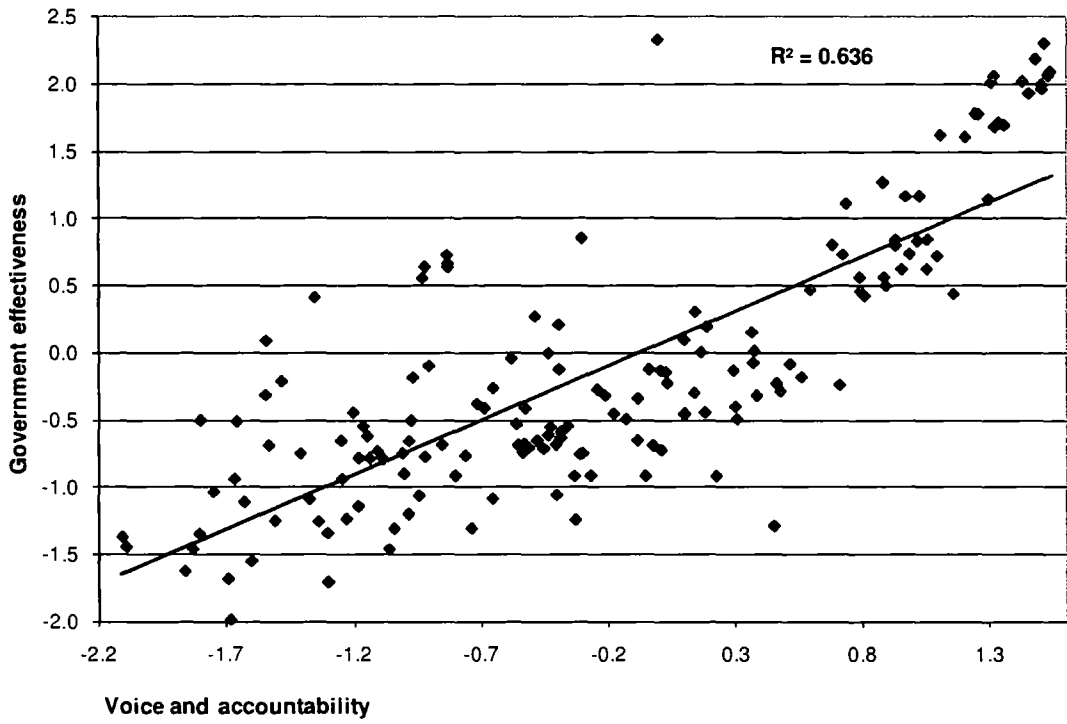
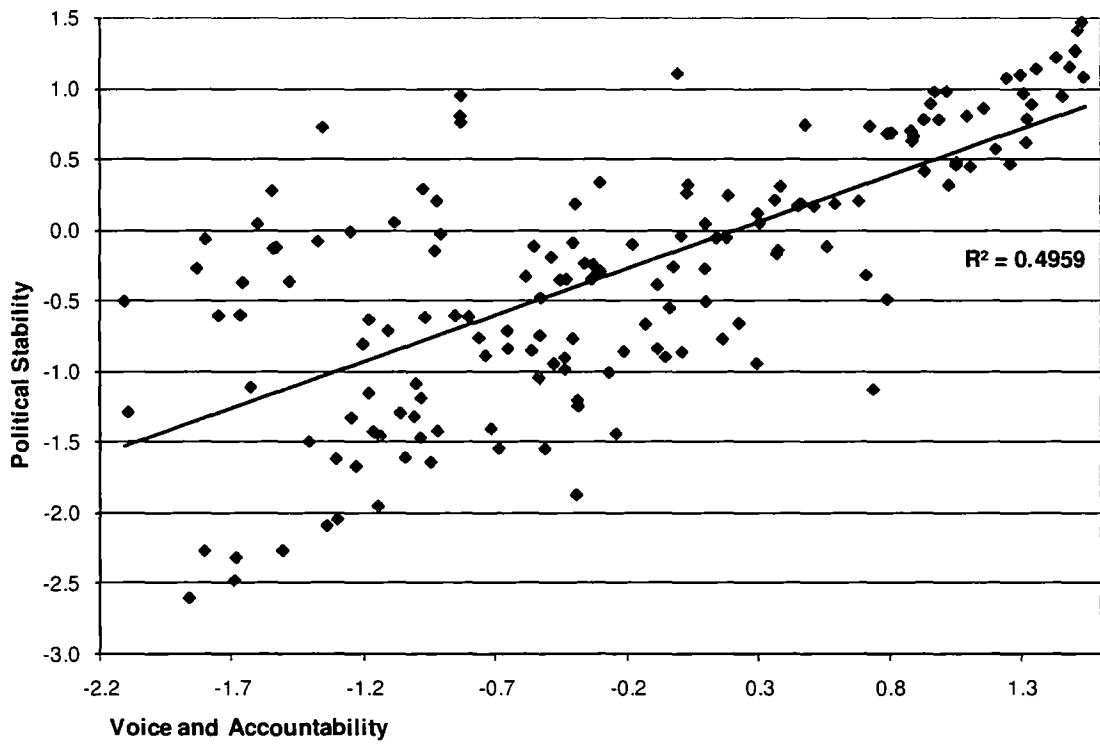


Figure 8



The positive relationships shown in figures 4 to 8 are not limited to a unique data set. Using different data sources, figure 9 shows how a measure of corruption from Transparency International (where a higher value means less corruption) relates to The Economist Intelligence Unit's measure of democracy for 2006 for a sample of 157 countries. Appendix 5 presents a list of the countries included and descriptive statistics.

Figure 9

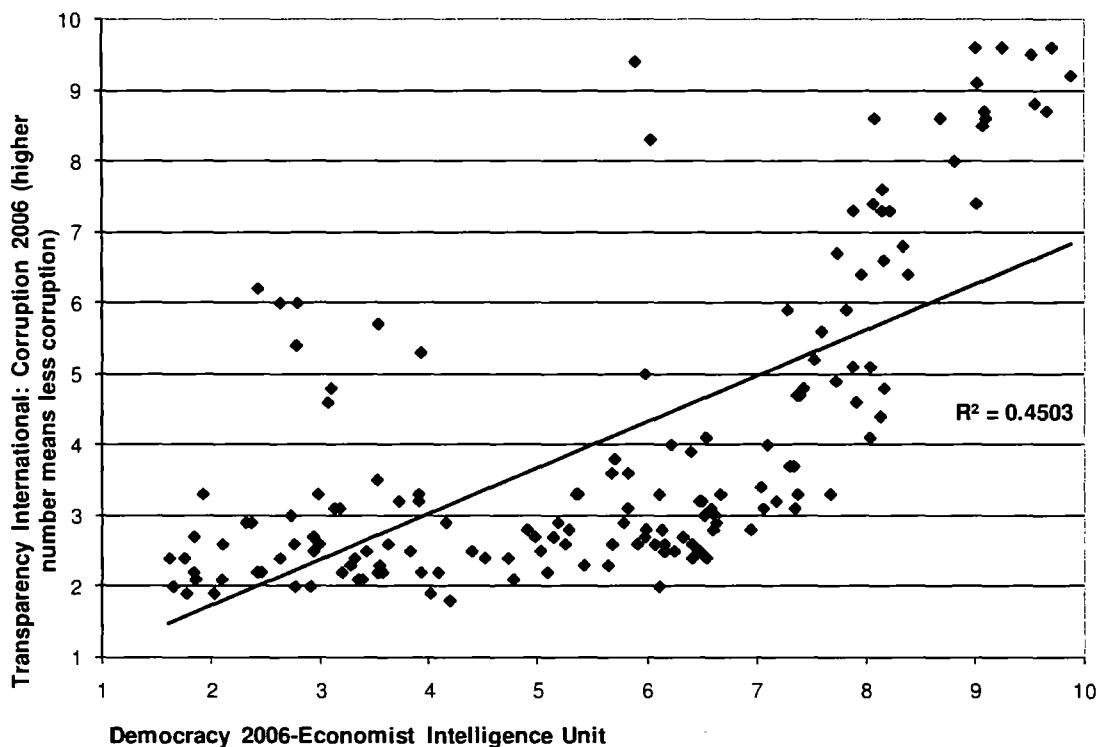
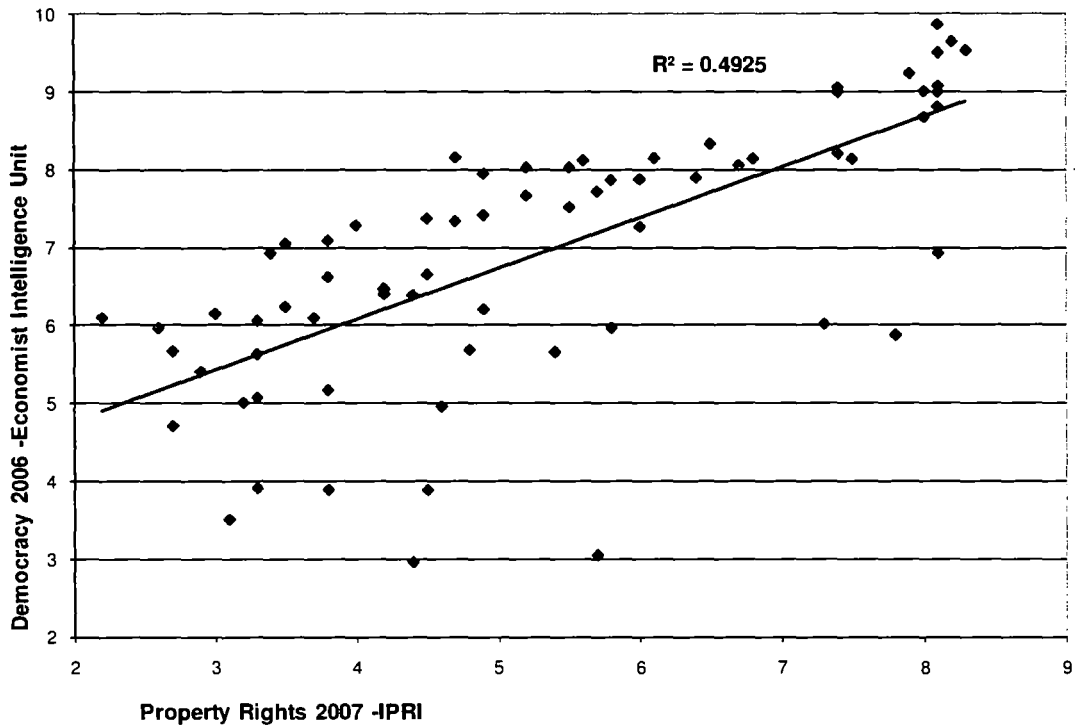


Figure 10 (next page) shows that as expected, property rights seem to be better protected in democratic countries. The data on property rights was obtained from the 2007 Report of the International Property Rights Index of Property Rights Alliance (Horst 2007). Figure 10 presents the scores of

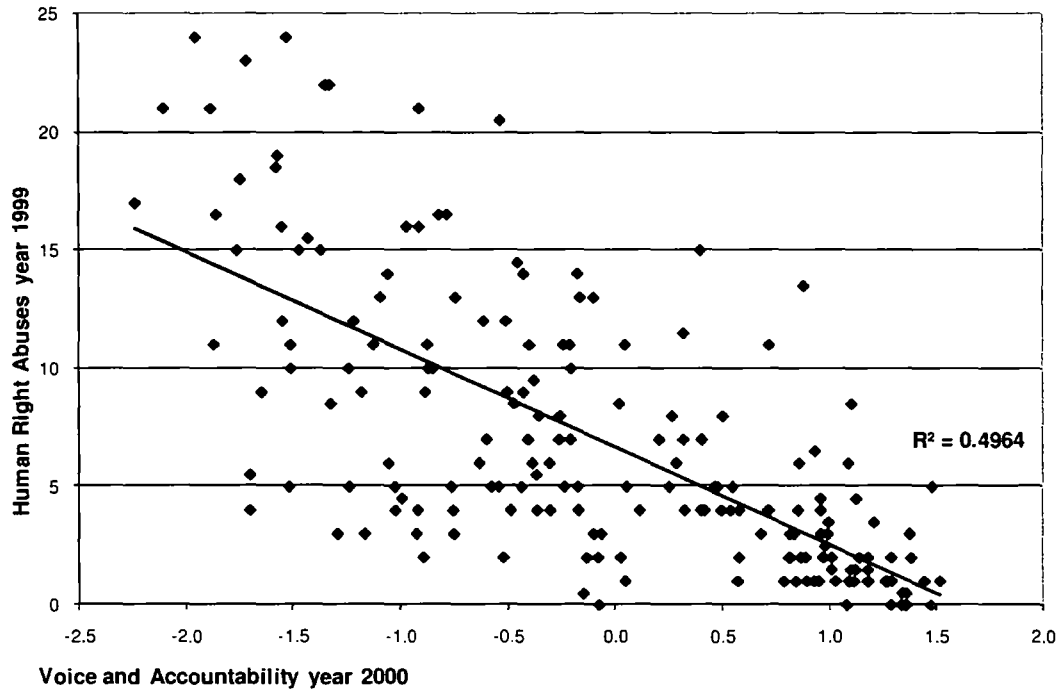
democracy (2006) and property rights (2007) for 69 countries. Appendix 6 presents a list of the countries included and descriptive statistics.

Figure 10



I mentioned that democratic countries are expected to be more respectful of human rights. Figure 11 (next page) confirms this for a sample of 184 countries, where democracy is proxied by the 'Voice and accountability' variable (as described above) for year 2000, and the number of Human Rights abuses for 1999 is taken from The Observer Human Rights Index as published in the special report of the 24th October 1999 (The Guardian, 24th October 1999). Appendix 7 presents a list of the countries included and descriptive statistics.

Figure 11

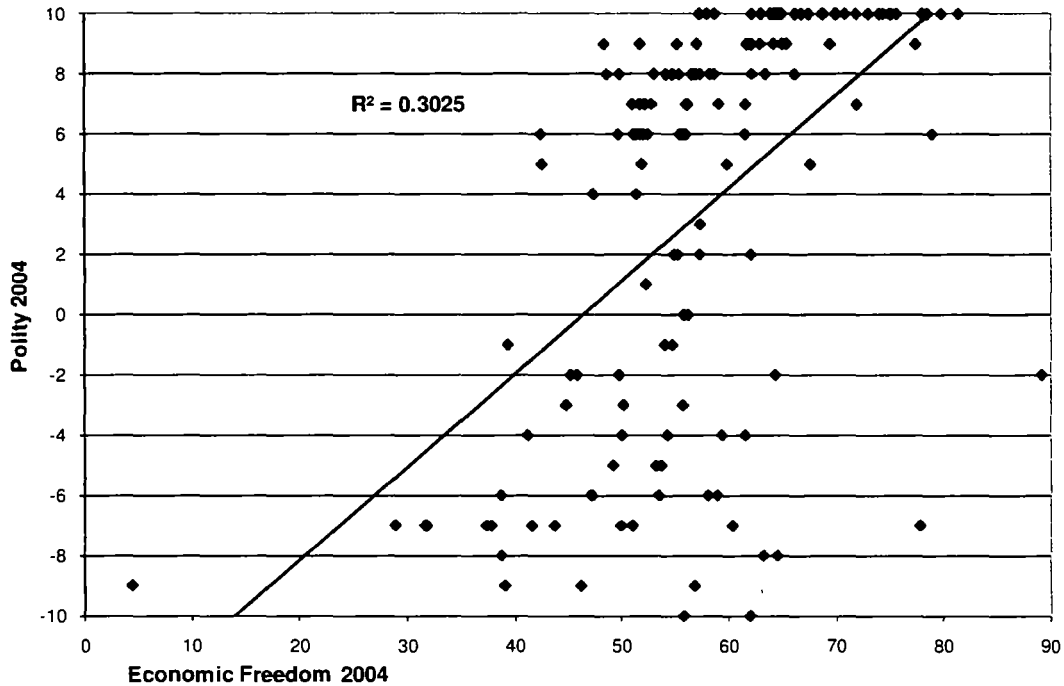


Through the eight channels of table 1 I argued that democracies are associated with more economic freedom, which can facilitate a more efficient allocation of talent, which is conducive to a greater impact of education on economic growth. Figure 12 (next page) presents the Polity variable together with the Economic Freedom Index from The Heritage Foundation (available at www.heritage.org/research/features/index/downloads.cfm) for a set of 142 countries in 2004. As expected, more democratic countries tend to have freer markets. Appendix 8 presents the list of countries included and descriptive statistics.

All the evidence and previous research discussed above shows that democracy is associated with a 'cloud of factors' (less corruption, fewer abuses of human rights, better law enforcement, rule of law, better regulatory quality and government effectiveness, stronger property rights, freer markets and more political stability) that represent institutional conditions which can

foster the impact of education on growth through the channels identified above.

Figure 12



Which of the factors of that cloud cause the others? This thesis does not answer this. Therefore, it may be democracy itself or the environment that surrounds it which is actually intervening in the link between education and growth. However, the arguments presented by previous researchers and the eight channels discussed above support the choice of democracy to map for the appropriate institutions that enhance the education-growth link (though it may not necessarily be the cause of the other factors). In other terms, I expect the lack of democracy and the failures associated with its absence to be the driving force behind the distortions that obstruct the link between education and growth.

Consequently, it is reasonable to ask whether the effect of education on growth depends on the level of democracy of the political system. This question is addressed empirically in chapter 4, but an answer is also suggested theoretically in chapter 3, which concludes that the economic gains of education should be more evident in democracy than in dictatorship.

Outline of chapters

Chapter 2 presents the disparities in cross-country public spending on education, and provides a model that shows how altruism could play a role in the determination of the differences in the rates of education subsidies. Novel datasets are exploited and new hypotheses are proposed, providing fresh resources for new research to focus on this field.

The question of why and how much to spend on education is taken up again in chapter 3, but from a very different perspective. Chapter 3 focuses on the trade-offs between education and defence faced by dictatorships. This trade-off poses limits to dictatorships, leading to the discussion of how the impact of education on economic growth affects the chances of a regime transition.

The discussion of the impact of education on economic growth is taken a step forward in chapter 4, which tests whether education affects growth regardless of the political system, or whether education under a democratic environment has different effects on growth than under non-democracy. A brief model is presented and the implications are tested using system-GMM estimation.

Chapter 5 concludes.

Appendix 1: Data for figure 1

Countries included: Afghanistan; Albania; Algeria; Angola; Argentina; Armenia; Australia; Austria; Azerbaijan; Bahrain; Bangladesh; Belarus; Belgium; Benin; Bhutan; Bolivia; Bosnia and Herzegovina; Botswana; Brazil; Bulgaria; Burkina Faso; Burundi; Cambodia; Cameroon; Canada; Central African Republic; Chad; Chile; China; Colombia; Comoros; Congo (Dem. Rep.); Congo (Rep.); Costa Rica; Croatia; Cuba; Cyprus; Czech Republic; Denmark; Djibouti; Dominican Republic; Ecuador; Egypt (Arab Rep.); El Salvador; Equatorial Guinea; Eritrea; Estonia; Ethiopia; Fiji; Finland; France; Gabon; Gambia; Georgia; Germany; Ghana; Greece; Guatemala; Guinea; Guinea-Bissau; Guyana; Haiti; Honduras; Hungary; India; Indonesia; Iran (Islamic Rep.); Iraq; Ireland; Israel; Italy; Ivory Coast; Jamaica; Japan; Jordan; Kazakhstan; Kenya; Korea (North); Korea (South); Kuwait; Kyrgyz Republic; Laos; Latvia; Lesotho; Liberia; Libya; Lithuania; Madagascar; Malawi; Malaysia; Mali; Mauritania; Mauritius; Mexico; Moldova; Mongolia; Morocco; Mozambique; Myanmar; Namibia; Nepal; Netherlands; New Zealand; Nicaragua; Niger; Nigeria; Norway; Oman; Pakistan; Panama; Papua New Guinea; Paraguay; Peru; Philippines; Poland; Portugal; Qatar; Romania; Russia; Rwanda; Saudi Arabia; Senegal; Serbia and Montenegro; Sierra Leone; Singapore; Slovakia; Slovenia; Solomon Islands; Somalia; South Africa; Spain; Sri Lanka; Sudan; Swaziland; Sweden; Switzerland; Syrian Arab Republic; Tajikistan; Tanzania; Thailand; Togo; Trinidad and Tobago; Tunisia; Turkey; Turkmenistan; Uganda; Ukraine; United Arab Emirates; United Kingdom; United States; Uruguay; Uzbekistan; Venezuela (RB); Vietnam; Yemen; Zambia; Zimbabwe.

Descriptive

statistics:

		Averages 1994-2004	
		Polity	Freedom House
Countries		157	157
Mean		2.71	3.81
Standard Deviation		6.45	1.90

Appendix 2: Data for figure 2

Countries included: Afghanistan; Albania; Algeria; Angola; Argentina; Armenia; Australia; Austria; Azerbaijan; Bahrain; Bangladesh; Belarus; Belgium; Benin; Bhutan; Bolivia; Bosnia-Herzegovina; Botswana; Brazil; Bulgaria; Burkina Faso; Burundi; Cambodia; Cameroon; Canada; Cape Verde; Central African Republic; Chad; Chile; China; Colombia; Comoros; Congo (Dem. Rep.); Congo (Rep.); Costa Rica; Croatia; Cuba; Cyprus; Czech Republic; Denmark; Djibouti; Dominican Republic; Ecuador; Egypt (Arab Rep.); El Salvador; Equatorial Guinea; Eritrea; Estonia; Ethiopia; Fiji; Finland; France; Gabon; Gambia; Georgia; Germany; Ghana; Greece; Guatemala; Guinea; Guinea-Bissau; Guyana; Haiti; Honduras; Hungary; Iceland; India; Indonesia; Iran (Islamic Rep.); Iraq; Ireland; Israel; Italy; Ivory Coast; Jamaica; Japan; Jordan; Kazakhstan; Kenya; Korea (North); Korea (South); Kuwait; Kyrgyz Republic; Laos; Latvia; Lebanon; Lesotho; Liberia; Libya; Lithuania; Luxembourg; Macedonia; Madagascar; Malawi; Malaysia; Mali; Malta; Mauritania; Mauritius; Mexico; Moldova; Mongolia; Montenegro; Morocco; Mozambique; Myanmar; Namibia; Nepal; Netherlands; New Zealand; Nicaragua; Niger; Nigeria; Norway; Oman; Pakistan; Panama; Papua New Guinea; Paraguay; Peru; Philippines; Poland; Portugal; Qatar; Romania; Russia; Rwanda; Saudi Arabia; Senegal; Serbia; Sierra Leone; Singapore; Slovakia; Slovenia; South Africa; Spain; Sri Lanka; Sudan; Suriname; Swaziland; Sweden; Switzerland; Syrian Arab Republic; Taiwan; Tajikistan; Tanzania; Thailand; Togo; Trinidad and Tobago; Tunisia; Turkey; Turkmenistan; United Arab Emirates; Uganda; Ukraine; United Kingdom; United States; Uruguay; Uzbekistan; Venezuela (RB); Vietnam; Yemen; Zambia; Zimbabwe.

Descriptive

statistics:

Values for year 2006		
	Economist	Freedom House
Countries	164	164
Mean	5.51	3.44
Standard Deviation	2.27	1.93

Appendix 3: Data for figure 3

Countries included: Afghanistan; Albania; Algeria; Angola; Argentina; Armenia; Australia; Austria; Azerbaijan; Bahrain; Bangladesh; Belarus; Belgium; Benin; Bhutan; Bolivia; Bosnia and Herzegovina; Botswana; Brazil; Bulgaria; Burkina Faso; Burundi; Cambodia; Cameroon; Canada; Central African Republic; Chad; Chile; China; Colombia; Comoros; Congo (Dem. Rep.); Congo (Rep.); Costa Rica; Croatia; Cuba; Cyprus; Czech Republic; Denmark; Djibouti; Dominican Republic; Ecuador; Egypt (Arab Rep.); El Salvador; Equatorial Guinea; Eritrea; Estonia; Ethiopia; Fiji; Finland; France; Gabon; Gambia; Georgia; Germany; Ghana; Greece; Guatemala; Guinea; Guinea-Bissau; Guyana; Haiti; Honduras; Hungary; India; Indonesia; Iran (Islamic Rep.); Iraq; Ireland; Israel; Italy; Ivory Coast; Jamaica; Japan; Jordan; Kazakhstan; Kenya; Korea (North); Korea (South); Kuwait; Kyrgyz Republic; Laos; Latvia; Lebanon; Lesotho; Liberia; Libya; Lithuania; Macedonia; Madagascar; Malawi; Malaysia; Mali; Mauritania; Mauritius; Mexico; Moldova; Mongolia; Morocco; Mozambique; Myanmar; Namibia; Nepal; Netherlands; New Zealand; Nicaragua; Niger; Nigeria; Norway; Oman; Pakistan; Panama; Papua New Guinea; Paraguay; Peru; Philippines; Poland; Portugal; Qatar; Romania; Russia; Rwanda; Saudi Arabia; Senegal; Serbia and Montenegro; Sierra Leone; Singapore; Slovak Republic; Slovenia; Solomon Islands; Somalia; South Africa; Spain; Sri Lanka; Sudan; Swaziland; Sweden; Switzerland; Syrian Arab Republic; Tajikistan; Tanzania; Thailand; Timor-Leste; Togo; Trinidad and Tobago; Tunisia; Turkey; Turkmenistan; Uganda; Ukraine; United Arab Emirates; United Kingdom; United States; Uruguay; Uzbekistan; Venezuela (RB); Vietnam; Yemen; Zambia; Zimbabwe.

Descriptive
statistics:

Averages 1996-2004		
	Voice and Accountability	Polity
Countries	160	160
Mean	-0.21	2.78
Standard Deviation	0.97	6.44

Appendix 4: Data for figures 4 to 8

Countries included: Afghanistan; Albania; Algeria; Angola; Argentina; Armenia; Australia; Austria; Azerbaijan; Bahrain; Bangladesh; Belarus; Belgium; Benin; Bhutan; Bolivia; Bosnia and Herzegovina; Botswana; Brazil; Bulgaria; Burkina Faso; Burundi; Cambodia; Cameroon; Canada; Central African Republic; Chad; Chile; China; Colombia; Comoros; Congo (Rep.); Congo (Dem. Rep.); Costa Rica; Croatia; Cuba; Cyprus; Czech Republic; Denmark; Djibouti; Dominican Republic; Ecuador; Egypt (Arab Rep.); El Salvador; Equatorial Guinea; Eritrea; Estonia; Ethiopia; Fiji; Finland; France; Gabon; Gambia; Georgia; Germany; Ghana; Greece; Guatemala; Guinea; Guinea-Bissau; Guyana; Haiti; Honduras; Hungary; India; Indonesia; Iran (Islamic Rep.); Iraq; Ireland; Israel; Italy; Ivory Coast; Jamaica; Japan; Jordan; Kazakhstan; Kenya; Korea (North); Korea (South); Kuwait; Kyrgyz Republic; Laos; Latvia; Lebanon; Lesotho; Liberia; Libya; Lithuania; Macedonia; Madagascar; Malawi; Malaysia; Mali; Mauritania; Mauritius; Mexico; Moldova; Mongolia; Morocco; Mozambique; Myanmar; Namibia; Nepal; Netherlands; New Zealand; Nicaragua; Niger; Nigeria; Norway; Oman; Pakistan; Panama; Papua New Guinea; Paraguay; Peru; Philippines; Poland; Portugal; Qatar; Romania; Russia; Rwanda; Saudi Arabia; Senegal; Serbia and Montenegro; Sierra Leone; Singapore; Slovak Republic; Slovenia; Solomon Islands; Somalia; South Africa; Spain; Sri Lanka; Sudan; Swaziland; Sweden; Switzerland; Syrian Arab Republic; Tajikistan; Tanzania; Thailand; Timor-Leste; Togo; Trinidad and Tobago; Tunisia; Turkey; Turkmenistan; Uganda; Ukraine; United Arab Emirates; United Kingdom; United States; Uruguay; Uzbekistan; Venezuela (RB); Vietnam; Yemen; Zambia; Zimbabwe.

Descriptive statistics:	Averages 1996-2005	Countries	Mean	Standard Deviation
Voice and Accountability		160	-0.21	0.97
Control of Corruption		160	-0.13	0.99
Rule of Law		160	-0.19	0.98
Regulatory Quality		160	-0.13	0.95
Government Effectiveness		160	-0.11	0.99
Political Stability		160	-0.28	0.91

Appendix 5: Data for figure 9

Countries included: Albania; Algeria; Angola; Argentina; Armenia; Australia; Austria; Azerbaijan; Bahrain; Bangladesh; Belarus; Belgium; Benin; Bhutan; Bolivia; Bosnia and Herzegovina; Botswana; Brazil; Bulgaria; Burkina Faso; Burundi; Cambodia; Cameroon; Canada; Central African Republic; Chad; Chile; China; Colombia; Congo (Dem. Rep.); Congo (Rep.); Costa Rica; Croatia; Cuba; Cyprus; Czech Republic; Denmark; Dominican Republic; Ecuador; Egypt (Arab Rep.); El Salvador; Equatorial Guinea; Eritrea; Estonia; Ethiopia; Finland; France; Gabon; Gambia; Georgia; Germany; Ghana; Greece; Guatemala; Guinea; Guyana; Haiti; Honduras; Hong Kong; Hungary; Iceland; India; Indonesia; Iran (Islamic Rep.); Iraq; Ireland; Israel; Italy; Ivory Coast; Jamaica; Japan; Jordan; Kazakhstan; Kenya; Korea (South); Kuwait; Kyrgyz Republic; Laos; Latvia; Lebanon; Lesotho; Libya; Lithuania; Luxembourg; Macedonia; Madagascar; Malawi; Malaysia; Mali; Malta; Mauritania; Mauritius; Mexico; Moldova; Mongolia; Morocco; Mozambique; Myanmar; Namibia; Nepal; Netherlands; New Zealand; Nicaragua; Niger; Nigeria; Norway; Oman; Pakistan; Panama; Papua New Guinea; Paraguay; Peru; Philippines; Poland; Portugal; Qatar; Romania; Russia; Rwanda; Saudi Arabia; Senegal; Serbia; Sierra Leone; Singapore; Slovakia; Slovenia; South Africa; Spain; Sri Lanka; Sudan; Suriname; Swaziland; Sweden; Switzerland; Syrian Arab Republic; Taiwan; Tajikistan; Tanzania; Thailand; Timor-Leste; Togo; Trinidad and Tobago; Tunisia; Turkey; Turkmenistan; Uganda; Ukraine; United Arab Emirates; United Kingdom; Uruguay; United States; Uzbekistan; Venezuela (RB); Vietnam; Yemen; Zambia; Zimbabwe.

Descriptive
statistics:

	Values for 2006	
	Economist	Corruption
Countries	157	157
Mean	5.61	4.08
Standard Deviation	2.24	2.17

Appendix 6: Data for figure 10

Countries included: Argentina; Australia; Austria; Bangladesh; Belgium; Bolivia; Brazil; Bulgaria; Canada; Chile; China; Colombia; Costa Rica; Czech Republic; Denmark; Ecuador; Egypt (Arab Rep.); El Salvador; Ethiopia; Finland; France; Germany; Greece; Guatemala; Honduras; Hong Kong; Hungary; India; Indonesia; Ireland; Israel; Italy; Japan; Kenya; Korea (South); Lithuania; Malawi; Malaysia; Mauritius; Mexico; Morocco; Netherlands; New Zealand; Nicaragua; Nigeria; Norway; Pakistan; Panama; Paraguay; Peru; Philippines; Poland; Portugal; Romania; Russia; Singapore; South Africa; Spain; Sweden; Switzerland; Tanzania; Thailand; Tunisia; Turkey; Ukraine; United Kingdom; United States; Uruguay; Venezuela (RB).

Descriptive statistics:

	Prop. Rights 2007	Economist 2006
Countries	69	69
Mean	5.32	6.96
Standard Deviation	1.79	1.67

Appendix 7: Data for figure 11

Countries included: Afghanistan; Albania; Algeria; Andorra; Angola; Antigua and Barbuda; Argentina; Armenia; Australia; Austria; Azerbaijan; Bahamas; Bahrain; Bangladesh; Barbados; Belarus; Belgium; Belize; Benin; Bhutan; Bolivia; Bosnia and Herzegovina; Botswana; Brazil; Brunei; Bulgaria; Burkina Faso; Burundi; Cambodia; Cameroon; Canada; Cape Verde; Central African Republic; Chad; Chile; China; Colombia; Comoros; Congo (Dem.

Rep.); Congo (Rep.); Costa Rica; Croatia; Cuba; Cyprus; Czech Republic; Denmark; Djibouti; Dominica; Dominican Republic; Ecuador; Egypt (Arab Rep.); El Salvador; Equatorial Guinea; Eritrea; Estonia; Ethiopia; Fiji; Finland; France; Gabon; Gambia; Georgia; Germany; Ghana; Greece; Grenada; Guatemala; Guinea; Guinea-Bissau; Guyana; Haiti; Honduras; Hong Kong; Hungary; Iceland; India; Indonesia; Iran (Islamic Rep.); Iraq; Ireland; Israel; Italy; Jamaica; Japan; Jordan; Kazakhstan; Kenya; Kiribati; Korea (North); Korea (South); Kuwait; Kyrgyz Republic; Laos; Latvia; Lebanon; Lesotho; Liberia; Libya; Liechtenstein; Lithuania; Luxembourg; Macedonia; Madagascar; Malawi; Malaysia; Maldives; Mali; Malta; Marshall Islands; Mauritania; Mauritius; Mexico; Micronesia; Moldova; Monaco; Mongolia; Morocco; Mozambique; Myanmar; Namibia; Nauru; Nepal; Netherlands; New Zealand; Nicaragua; Niger; Nigeria; Oman; Pakistan; Panama; Papua New Guinea; Paraguay; Peru; Philippines; Poland; Portugal; Qatar; Romania; Russia; Rwanda; Samoa; Sao Tome and Principe; Saudi Arabia; Senegal; Seychelles; Sierra Leone; Singapore; Slovak Republic; Somalia; South Africa; Spain; Sri Lanka; St Kitts and Nevis; St Lucia; St Vincent and the Grenadines; Sudan; Suriname; Swaziland; Sweden; Switzerland; Syrian Arab Republic; Taiwan; Tajikistan; Tanzania; Thailand; Togo; Tonga; Trinidad and Tobago; Tunisia; Turkey; Turkmenistan; Uganda; Ukraine; United Arab Emirates; United Kingdom; United States; Uruguay; Uzbekistan; Vanuatu; Venezuela (RB); Vietnam; Yemen; Zambia; Zimbabwe.

Descriptive statistics:

	Voice and Accountability 2000	Human Rights Abuses 1999
Countries	184	184
Mean	-0.07	6.99
Standard Deviation	1.01	5.89

Appendix 8: Data for figure 12

Countries included: Albania; Algeria; Angola; Argentina; Armenia; Australia; Austria; Azerbaijan; Bahrain; Bangladesh; Belarus; Belgium; Benin; Bolivia; Bosnia and Herzegovina; Botswana; Brazil; Bulgaria; Burkina Faso; Burundi; Cambodia; Cameroon; Canada; Central African Republic; Chad; Chile; China; Colombia; Congo (Dem. Rep.); Congo (Rep.); Costa Rica; Croatia; Cuba; Cyprus; Czech Republic; Denmark; Djibouti; Dominican Republic; Ecuador; Egypt (Arab Rep.); El Salvador; Equatorial Guinea; Estonia; Ethiopia; Fiji; Finland; France; Gabon; Gambia; Georgia; Germany; Ghana; Greece; Guatemala; Guinea; Guinea-Bissau; Guyana; Haiti; Honduras; Hungary; India; Indonesia; Iran (Islamic Rep.); Iraq; Ireland; Israel; Italy; Ivory Coast; Jamaica; Japan; Jordan; Kazakhstan; Kenya; Korea (North); Korea (South); Kuwait; Kyrgyz Republic; Laos; Latvia; Lebanon; Lesotho; Libya; Lithuania; Macedonia; Madagascar; Malawi; Malaysia; Mali; Mauritania; Mauritius; Mexico; Moldova; Mongolia; Morocco; Mozambique; Myanmar; Namibia; Nepal; Netherlands; Nicaragua; Niger; Nigeria; Oman; Pakistan; Panama; Paraguay; Peru; Philippines; Poland; Qatar; Romania; Russia; Rwanda; Saudi Arabia; Senegal; Serbia and Montenegro; Sierra Leone; Singapore; Slovak Republic; Somalia; South Africa; Sri Lanka; Sudan; Swaziland; Syrian Arab Republic; Tajikistan; Tanzania; Thailand; Togo; Trinidad and Tobago; Tunisia; Turkey; Turkmenistan; Uganda; Ukraine; United Arab Emirates; Uzbekistan; Venezuela (RB); Vietnam; Yemen; Zambia; Zimbabwe.

Descriptive statistics:

Values for 2004		
	Economic Freedom	Polity
Countries	142	142
Mean	57.68	3.51
Standard Deviation	11.86	6.66

Chapter 2

What drives the cross-country variation on education subsidies?

Abstract

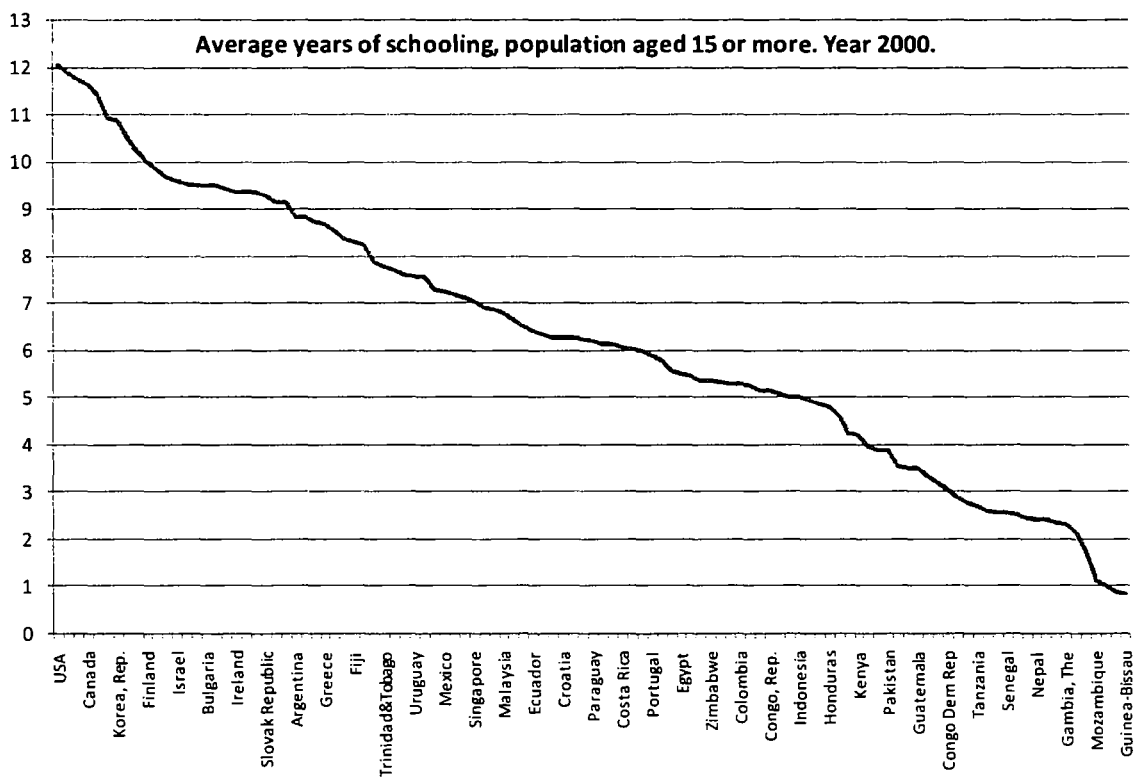
To help explain the variation of public expenditure on education across countries, I focus on the part of that expenditure that results from subsidising households' expenditure on education. An overlapping generations model shows that countries that are less altruistic and less short-sighted should set higher rates of subsidy. I provide exploratory evidence that richer countries tend to be less altruistic than their poorer counterparts, which contributes to explain why poorer countries transfer fewer public resources to education even though their private and social returns tend to be greater than in richer countries.

Introduction

Part of the previous chapter discussed how education affects economic growth, and the different approaches towards that relationship. This chapter provides an insight into one of the factors that may contribute to the explanation of the cross-country variation in the provision of public education.

Education, as measured by the average years of schooling of individuals aged 15 years or more (from the Barro-Lee dataset, Barro and Lee 1993, 2000) exhibits an important variation across countries. Figure 1 shows data for year 2000¹⁴.

Figure 1



¹⁴ Data for the average years of schooling of the population aged 25 and more shows a very similar pattern.

The factors that explain the variation of figure 1 could be various and are beyond the scope of this chapter. One of the possible causes of that variation is the amount of resources (private or public) devoted to education: it is reasonable to expect that extending education requires the use of resources, and that more education requires more resources. This is not only intuitive but also assumed by previous scholars. For example, when researchers try to find a relationship between education expenditure and economic growth (Sylwester 2000, Bräuninger and Vidal 1999, Zhang 1996, Blankenau and Simpson 2003, Blankenau 2005), they are assuming that education expenditure *creates* education, which in turn has an effect on economic growth. This is also a standard feature in models that focus on the relationships between education, inequality and growth (for example Saint-Paul and Verdier 1993, Bourguignon and Verdier 2000, Sylwester 2000), in which transfers from the rich to the poor take the form of education expenditure, which in turn has effects on economic growth.

Gradstein, Justman and Meier (2005) survey the literature and conclude that “*There seems to be no doubt that spending on education matters in absolute sense. Thus, in international macroeconomic comparisons, especially those that include less advanced countries, more spending is typically associated with better educational outcomes*” (Gradstein, Justman and Meier 2005, page 34). When looking at the total expenditure on education, Gradstein, Justman and Meier (2005) note the high share that public education expenditure has of total education expenditure. They claim that among the OECD countries, more than 90% of total education spending comes from the state, while among developing countries the share is lower but still high. This is confirmed in table 1, which shows the share of public

expenditure on education over total expenditure on education for 46 countries from the EdStats Database (World Bank)¹⁵.

Table 1

Public expenditure in education as a share of total expenditure on education, average 1996-2002.

Country	All levels	Primary + Secondary	Country	All levels	Primary + Secondary
Malaysia	99.3	99.0	Thailand	85.4	
Portugal	98.5	99.9	Mexico	85.0	86.6
Finland	97.9	99.3	Canada	83.3	92.1
Norway	97.4	99.2	New Zealand	82.5	89.6
Sweden	97.1	99.9	Israel	81.6	95.0
Denmark	95.7	97.9	Germany	80.2	78.5
Greece	95.4	93.1	Argentina	80.1	88.2
Slovak Republic	95.3	97.9	Australia	77.2	84.8
Austria	95.1	96.4	Japan	75.1	91.7
Belgium	93.9	94.0	Bolivia	75.0	
Uruguay	93.6	93.8	Cambodia	73.0	
France	93.6	94.5	United States	72.2	91.2
Italy	93.5	98.1	Paraguay	65.3	74.3
Netherlands	93.0	95.3	Indonesia	64.4	76.4
Turkey	92.7	83.9	Peru	64.3	67.8
Switzerland	92.1	87.9	Honduras	62.0	
Ireland	91.7	96.4	Korea, Rep.	59.1	79.8
Iceland	91.6	95.1	Philippines	58.8	65.3
Czech Republic	89.5	90.9	Korea, Dem. Rep.	58.3	77.4
Poland	89.2	97.1	Chile	56.2	69.6
Hungary	88.6	92.6	Jamaica	49.6	52.4
United Kingdom	87.2	87.7	Dominican Republic	45.5	
India	86.5	89.9	Jordan		98.2
Spain	85.8	90.8	Turkmenistan		98.0
			Total Average	81.8	89.0

Therefore, any attempt to understand the cross-country variation of education expenditure must account for variations in public expenditure on education. What motivates public expenditure on education? Why do countries differ in their levels of public expenditure on education?

Gradstein, Justman and Meier (2005) survey the literature and refer to several possible factors that could explain why countries spend public money

¹⁵ Data accessible on <http://go.worldbank.org/9QOK7QK8Y0>

on education. The first factor that they identify is the existence of positive externalities and spillover effects that result from a more educated population. As they admit, empirical support for this has been elusive, with estimates of social returns to education being below the private returns. A second factor that could explain public intervention on education is the existence of other spillovers not directly linked to economic growth: education may decrease criminal activity and child mortality, improve life expectancy, extend political rights, improve environmental quality, etc. A third factor is social cohesion: public education provides some common norms that favour interpersonal trust and facilitate interaction. A fourth factor is imperfect credit markets, which could limit the access of some sectors to education.

Pritchett (2004) claims that justifying public expenditure on education on the basis of positive macroeconomic returns is difficult, because of the elusiveness of those returns (discussed in the previous chapter). For that reason, he argues that the decision to spend more or less public resource on education is driven by factors other than private, social or macroeconomic returns¹⁶. In consequence, Pritchett (2003) presents a model that explains why nearly all countries have public educational policies, without referring to the macroeconomic effects of education on growth. He argues that schooling conveys beliefs, and that the rulers of a nation are not indifferent about these beliefs. To control the beliefs embedded on instruction, powerful national regimes sought control of the beliefs instruction directly, so public schooling became a dominant form of schooling. Public schooling later expanded due to

¹⁶ “[S]ince I do not believe that beliefs about output externalities have played any role in creating or expanding support for education I am perfectly comfortable that my assessment that there is no evidence for output externalities in the cross national data does not work at cross purposes with my normative beliefs that expending high quality schooling through public sector support is key to expansions in human welfare” (Pritchett 2004, page 83). Weiss (1995) raises a similar point: “education does not have to be justified solely on the basis of its effect on labour productivity. This was certainly not the argument given by Plato or de Tocqueville and need not be ours. Students are not taught civics, or art, or music solely in order to improve their labour productivity but rather to enrich their lives and make them better citizens” (Weiss 1995, p. 151)

supply (pressure of strongly ideological regimes) or demand (pressure of increasingly powerful citizens).

From the perspective of the private and social returns to education, Psacharopoulos (1993) and Psacharopoulos and Patrinos (2002) show that education appears to behave like other factors of production in the sense that it experiences diminishing returns¹⁷. According to those results one should expect poorer countries to spend relatively more on education than richer countries, where the marginal productivity of education is lower. Theoretically, if poorer countries kept on spending more on education, the gap in productivity and level of income should disappear in the long run. However, Psacharopoulos has measured the returns to education over a long period (1973, 1985, 1993, 2002) and the results show that the gap is still present (social returns to education in richer countries are lower than in poorer countries). More strikingly, poorer countries have been spending relatively less public money on education than richer countries (see data below), which probably explains the persistence of the productivity gap.

Table 2 shows data on total public spending on education as a share of GDP from the World Bank Development Indicators.

Table 2

Education expenditure per student / GDP per capita (%)

Category	1991	1998	1999	2000	2001	2002	2003	2004
Low income	2.76		2.96	3.13				
Lower middle income	3.87		4.44	4.19	4.41	4.18	4.81	
Upper middle income	4.08	4.04	4.15	3.92	4.17	4.29	4.38	4.11
High income	4.90	4.95	5.18	4.68	5.22	5.48	5.48	5.39

Source: World Bank, World Development Indicators (WDI), April 2008, ESDS International, (Mimas), University of Manchester.

¹⁷ In Psacharopoulos, 'social return' does not refer to macroeconomic return. Social returns include private benefits less total costs (private plus external). Social returns are always lower than private returns because the social costs include public expenditure on education, which is not considered in the private returns.

A test of difference of means cannot be performed because the World Bank presents the data already aggregated in the categories shown. Data for 1992-1997 are not directly available. For this reason table 3 presents unweighted averages of the variable presented in table 2, where I categorise the countries by their income levels following the classification of the World Bank¹⁸. This allows for the computation of a test of difference in means.

These two tables suggest that richer countries have tended to spend relatively more public resources on education than poorer countries, and that the proportion of public resources devoted to education seems to be significantly different between poor and rich countries.

Table 3

Education expenditure / GDP (%). Simple average of countries' values

	High income	Upper Middle income	Lower Middle income	Low income	Difference High-Low	p-value for T-test in differences in means (high vs low)
1985	4.72	5.11	4.75	2.96	1.76	0.00***
1986	4.78	4.61	5.34	2.70	2.08	0.00***
1987	4.62	4.28	4.22	3.40	1.23	0.02**
1988	4.75	4.05	4.30	3.45	1.30	0.02**
1989	4.55	3.74	4.45	3.38	1.17	0.05**
1990	4.56	4.42	4.46	3.83	0.73	0.20
1991	4.46	4.19	4.59	3.53	0.93	0.08*
1992	4.81	4.64	4.46	4.26	0.55	0.38
1993	4.90	4.67	4.65	4.20	0.69	0.21
1994	5.19	4.71	4.87	3.77	1.42	0.00***
1995	5.05	4.65	4.63	3.71	1.34	0.00***
1996	5.03	4.65	5.05	3.57	1.46	0.00***
1997	4.58	4.38	5.08	2.89	1.69	0.08*
1998	5.08	5.16	4.82	2.91	2.18	0.00***
1999	5.11	5.60	4.76	3.03	2.08	0.00***
2000	4.81	5.61	5.07	3.30	1.51	0.00***
2001	5.12	5.40	5.37	3.52	1.59	0.00***
2002	5.23	5.61	5.20	3.50	1.74	0.00***
2003	5.40	5.43	5.04	3.46	1.94	0.00***
2004	5.13	5.22	4.82	3.40	1.73	0.00***
2005	4.78	5.25	5.41	3.81	0.97	0.04**

Source: EdStats, World Bank (July 2008). Countries classified according to the World Bank.

Notes: *** stands for significant at 1% level, ** significant at 5% level, * significant at 10% level.

¹⁸ See

http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20421402~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html#High_income

Data on total public expenditure on education per student as a share of per capita GDP show the same pattern. This variable has the benefit of avoiding differences in education expenditure that are due to demographic differences across countries, such as a greater or smaller proportion of population being of school age. As it is presented in terms of GDP per capita, this variable avoids the observation of differences on education expenditure that are due to the scale of the national economies. Data for educational expenditure across countries are scarce, and data for this more specific variable are even scarcer. Unweighted averages for this variable (education expenditure per student as a share of GDP per capita) can be calculated using data from the EdStats database of the World Bank. Table 4 groups the countries by the same income categories as above.

Table 4

Education expenditure per student / GDP per capita (%)
Simple average of countries' values

	High income	Upper Middle income	Lower Middle income	Low income	Difference High-Low
1998	19.91	19.76	13.85	N/A	
1999	22.95	20.06	20.78	18.54	4.41
2000	22.23	18.78	20.75	12.95	9.28
2001	23.48	19.75	19.36	15.22	8.25
2002	23.78	18.71	18.63	13.80	9.98
2003	24.74	19.70	18.25	18.14	6.60
2004	24.11	18.02	17.24	16.55	7.55
2005	22.99	19.80	17.40	18.34	4.65

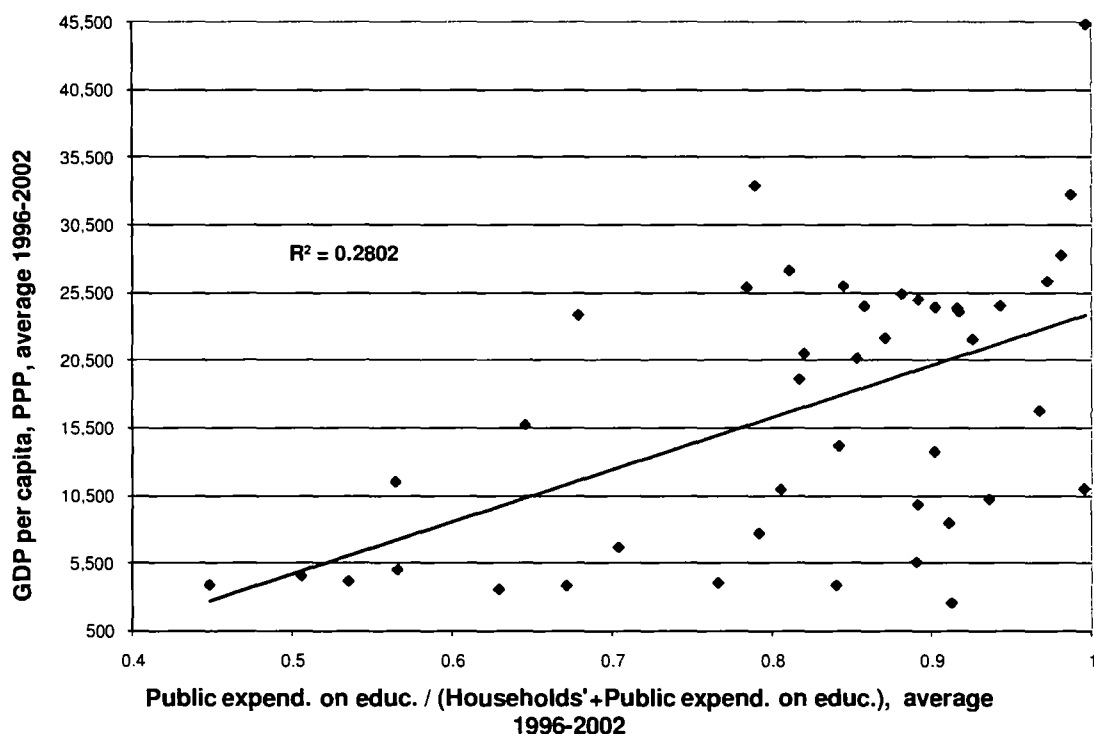
Source: EdStats, World Bank (July 2008). Countries classified according to the World Bank.

A difference of means test is not presented because of the low number of observations in the category 'low income'. Only in 2005 there are more than 10 countries in this category. Due to this scarcity of data, the numbers should be taken with caution. Table 4 also suggests that poorer countries did not spend more on education than richer countries. Furthermore, it suggests that richer countries spent relatively more on education than poorer countries.

This may explain why the productivity gap mentioned above has not closed over time.

Another measure of the differences in public expenditure on education is the ratio of public expenditure on education to total expenditure on education (which includes public expenditure and expenditure of households). This variable¹⁹ is shown in figure 2 together with the GDP per capita for a group of 44 countries. A list of the countries included and descriptive statistics are presented in appendix 1.

Figure 2



¹⁹ I compute this variable using data for household and government expenditure on education from the Organisation for Economic Development and Cooperation, Education Statistics, Volume 2006, Issue 01, ESDS International, (Mimas) University of Manchester. The source for GDP per capita in constant US\$ (year 2000) is World Bank, World Development Indicators (WDI) April 2007, ESDS International, (MIMAS) University of Manchester.

Finally, table 5 provides econometric evidence that countries with a higher GDP per capita tend to devote more public resources to education as a share of GDP. The regressions are cross-country, using average values for each country for the period 1999-2002. Appendix 2 presents the sources of data; appendix 3 presents a list of the countries included in the regressions and descriptive statistics.

Table 5

Dependent variable: Public education expenditure /GDP

	(1)	(2)	(3)	(4)
Constant	6.475365 (0.99)	3.8746810 ** (2.46)	5.0371300 (0.76)	1.955556 (1.21)
GDP per capita, constant prices, '000	0.0409 * (1.72)	0.0395 ** (2.22)		
GDP per capita, PPP, '000			0.0929 *** (3.19)	0.0901 *** (3.84)
Public expenditure/GDP	0.1013133 *** (4.17)	0.0565867 *** (3.14)		
Public expenditure/GDP, PPP			0.0517585 *** (3.31)	0.057624 *** (4.03)
Investment/GDP	-0.0158723 (-0.76)	-0.0085322 (-0.41)		
Investment/GDP, PPP			-0.0160283 (-0.64)	-0.0168579 (-0.73)
Trade/GDP	0.006240 * (1.77)	0.0036379 -1.12		
Trade/GDP, PPP			0.0059188 * (1.77)	0.0040500 (1.30)
Population 0-14 years/Total population	-0.0305800 (-0.57)		-0.0161686 (-0.30)	
Population 15-64 years/Total population	-0.0628829 (-0.82)	-0.0117211 (-0.45)	-0.0576044 (-0.74)	-0.0064823 (-0.22)
Degree of democracy	0.7918723 (1.35)		1.1483870 * (1.92)	0.7983138 (1.53)
M2/GDP	0.0027267 (0.42)		0.0058163 (0.89)	
R squared	0.2915	0.1407	0.2702	0.2459
Adjusted R squared	0.2375	0.1089	0.2161	0.2091
Countries	114	141	117	130

Notes: t-values in parentheses. *** stands for significant at 1% level, ** significant at 5%, * significant at 10%. All the variables represent average values for each country for the period 1999-2002.

The regressions of table 5 relate public expenditure on education as a share of GDP to GDP per capita (main regressor) and a series of controls. Total public expenditure as a share of GDP and investment as a share of GDP are included to control for differences in public education expenditure that could arise from differences on how different countries allocate public resources in general, or from other structural differences. If two countries differ in their degree of intervention in the economy or in their investment patterns for reasons not considered here, they could also spend differently on education. I include these two regressors (Public expenditure/GDP and Investment/GDP) to control for that source of variation.

I include a regressor that controls for the degree of openness of the economy (trade/GDP) to control for whether countries spend differently in public education because they need to 'catch up' with their commercial competitors and counterparts. A hypothesis could be that countries that are commercially more open are more exposed to foreign competition, so they need to make sure that they remain competitive and thus spend more on public education. I include two controls that account for the age structure of the population to ensure that differences in public expenditure on education are not due to differences in the shares of population that are of school age. I include a control that accounts for the degree of democracy to account for the possibility (discussed in chapter 1) that more democratic countries use the expansion of public education as a way of redistribution. Finally, I include a measure of monetary expansion (M2/GDP) to control for other possible sources of variation in the public finances that may account for differences in the public expenditure on education.

The first two regressions of table 5 use GDP per capita in constant terms, as well as public expenditure as a share of GDP, investment as a share of GDP and a measure of trade as a share of GDP (imports+exports/GDP); regressions 3 and 4 introduce those variables adjusted by PPP. Regressions are shown with and without PPP adjustments because the dependent variable

(public expenditure on education /GDP) is not available in PPP terms: although it is a ratio, in order to be accurate the numerator should also be expressed in PPP (in fact, the ratios investment/GDP and public expenditure/GDP are available with and without PPP adjustment). For this reason, it is not completely consistent to run regressions where the dependent variable is not PPP adjusted but the regressors are. However, given that PPP measures have some benefits for cross-country comparisons, table 5 presents the results obtained with and without the PPP adjusted regressors.

In all the regressions the level of GDP per capita (however measured) enters with a positive sign, with at least a 10% significance, suggesting that indeed, richer countries tend to devote more public resources to education as a share of GDP.

The definition of the variable ‘Public education expenditure as a share of GDP’ is “*government spending on educational institutions (both public and private), education administration as well as subsidies for private entities (students/households and other private entities)*” (World Bank, World Development Indicators, ESDS International, (Mimas) University of Manchester). According to this definition, we can think of total public education expenditure as consisting of three components: a fixed amount spent for education administration and educational institutions (E_i), subsidies to the education expenditure of households (where the subsidy rate is ω_i), and subsidies to other private entities (subsidy rate v_i). The cross-country variation in public education expenditure can be originated from variations in the fixed amount spent, or from variations in either of the two subsidies paid, so

$$\text{Total Public Education Expenditure}_i = E_i + h_i \cdot \omega_i + p_i \cdot v_i$$

where h_i is the education expenditure of households in country i and p_i refers to the education expenditure of other private entities in country i .

In this chapter I contribute to the explanation of variations in the cross-country public education expenditure by focusing on some of the possible determinants of ω_i and deliberately ignoring the other possible factors, also ignoring the possibility of changes in ω_i over time. In particular, I explore how altruism can affect the determination of the rate of subsidy ω_i . I am not aware of any similar approach to studying the cross-country variation in public education expenditure. One of the reasons for this may be the lack of data on cross-country rates of educational subsidy and levels of altruism. I present two proxies to cover for this absence of data, which I describe below. Bräuninger and Vidal (2000) analyse the impact of public subsidies to education on economic growth (they do not provide empirical evidence), and they also consider altruism in their model. However, their focus is economic growth, so their level of subsidies does not depend on altruism and is given exogenously.

If people receive education early in their lives (when they are children), they do not decide how much education should be provided for themselves: the older generations decide for them. If those who make the budgetary decisions assign different values to the education of future generations (they differ in the utility they obtain from educating their children, i.e., their intergenerational degree of altruism differs), then they will probably differ in the rate of education subsidies they will set. The initial research hypothesis of this chapter establishes that countries with different levels of altruism will differ in the level of education subsidies that they will set. Specifically, the hypothesis is that countries with greater levels of private intergenerational altruism will need lower levels of public education subsidies. The intuition is that more private altruism necessitates lesser public subsidies to education, because more altruistic parents will naturally spend more on their offspring's education.

The second section presents some data that suggest that more altruistic countries tend to set lower subsidies to education. The third section lays out an

overlapping generations model that provides an explanation for the data of the second section. The fourth section concludes.

Data

In this section I observe whether a relationship between the level of altruism and the level of public education subsidies exists in the data. Among other aspects, this requires a measure of education subsidies and a measure of altruism. There is almost no research on cross-country altruism and how it relates to income or other macroeconomic variables. The research available is mostly theoretical or based on case-studies (among many others, Stark 1995, Andreoni 1989, 1990, Amegashie 2006, Gérard-Varet, Kolm, Mercier Ythier 2000).

There is no internationally comparable indicator for the level of subsidies to education. I operationalise the rate of subsidy (ω) as the fraction of the private expenditure on education that the government refunds to the private individual who makes the expenditure. For example, if an individual spends h on education, then a rate of subsidy ω means that the individual receives a subsidy of $\omega.h$ units. In conclusion, of the total expenditure on education h , there are $\omega.h$ units originated in public resources and $(1-\omega).h$ originated in private resources. According to this operationalisation,

$$\frac{\text{Public expenditure on education}}{\text{Total expenditure on education}} = \frac{\omega.h_i}{\omega.h_i + (1-\omega).h_i} = \omega$$

According to this, taking [(Public expenditure on education / (Public + Households' expenditure on education))] should make a reasonably good proxy for the rate of public subsidies to education. I call this proxy *Subsidies*. Figure 1 (presented above) shows data on ω (horizontal axis) as defined here. Though a very imperfect measure of subsidies, the aim of this variable is to capture

how much resource the government allocates to education as a share of the total resources allocated to education by the government and households.

For robustness, I also take an alternative measure which includes total private expenditure instead of households' expenditure. This proxy is then computed as $[(\text{Public expenditure on education} / (\text{Public} + \text{Total private expenditure on education}))]$, where 'total private expenditure on education' includes the expenditure of households but also the expenditure of private institutions (firms). I call this proxy *Subsidies-Extended*.

Regarding the level of altruism, I use two measures derived from one variable. The first proxy for altruism comes from question A026 of the World Values Survey²⁰: "*Which of the following statements best describes your views about parents' responsibilities to their children?: A- Parents' duty is to do their best for their children even at the expense of their own well-being; B- Parents have a life of their own and should not be asked to sacrifice their own well-being for the sake of their children*".

The proxy for altruism is the percentage of people choosing answer A from the previous question in each country. The survey is carried out in different years in different countries, and most countries have only one available observation for the period 1994-2004 (where there are two available observations for a country I take the average of these two). Though arguably an imperfect measure of altruism, this may be the first time that this variable is used as a measure of altruism for cross-country comparisons, and possibly the first time that a cross-country measure of altruism is presented at all in the literature. I call this proxy *Altruism*. Previous research has used monetary transfers made by individuals as a proxy for altruism. For example, Bouhga-

²⁰ European and World Value Survey four-wave integrated data file, 1981-2004, v.20060423, 2006. The European Values Study Foundation and World Values Survey Association. Aggregate File Producers: ASEP/JDS, Madrid, Spain/Tilburg University, Tilburg, The Netherlands. Aggregate File Distributors: ASEP/JDS and ZA, Cologne, Germany.

Hagbe (2006) looks at the remittances of migrant workers as an expression of their altruism. Andreoni (2006) compares altruism across countries by looking at the percentage of cash revenues of the non-profit sector that are received from philanthropy. Castillo and Carter (2002) run behavioural experiments in South African communities, and derive their measure of altruism from the amount of money that the individuals are willing to transfer in their 'dictator game'. However, these are not real proxies for altruism but rather some of its consequences. Furthermore, those measures tend to be aggregated and not standardised²¹, whereas the measure presented here focuses particularly on altruism from parents to children, which is the focus of this chapter.

A second proxy for altruism is a variation of the proxy *Altruism*. Let us consider a dummy variable that takes value 1 when a country has a value of *Altruism* above the median of the sample, and 0 when the country has a value below the median. In other words, this proxy is a dummy that indicates whether the country is relatively 'altruistic' or 'non-altruistic' when compared to the set of countries with available data. I call this proxy *Altruism Dummy*.

Due to the lack of time series data for altruism (which is a crucial variable in this analysis), table 6 presents the results of cross-country regressions, where variables are averaged for the period 1992-2002. These regressions capture the effect of altruism on subsidies after controlling for a number of macroeconomic variables (they are included for reasons similar to those already discussed for the regressions of table 5). The reader should bear in mind that this is a first exploratory observation of the effects of altruism at cross-country level, and that better measures of altruism and subsidies to education are needed. The list of countries included in each specification of table 6 is presented in appendix 4, together with some descriptive statistics.

²¹ "A difficult aspect of comparing data from across countries is the varied sources of information and the inconsistent definitions of charitable giving and non-profit organizations" (Andreoni 2006, page 1209).

<i>Dependent variables:</i>	Subsidies	Subsidies	Subsidies	Subsidies	Subsidies- Extended	Subsidies- Extended
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	1.0586840 *** (8.68)	0.8816712 *** (42.02)	1.246569 ** (2.52)	1.030423 *** (3.95)	1.142059 ** (2.86)	0.8358496 *** (4.51)
Altruism	-0.0029701 * (-1.76)		-0.0044573 (-1.44)		-0.0044899 (-1.64)	
Altruism dummy		-0.0947775 *** (-2.78)		-0.1333864 ** (-2.48)		-0.117514 ** (-2.55)
GDP per capita, PPP			6.90E-06 (1.58)	5.43E-06 (1.49)	6.46E-06 * (1.85)	4.30E-06 (1.42)
Trade/GDP, PPP			0.0000728 (0.09)	-0.0004735 (-0.65)	0.0004737 (0.67)	-0.0000205 (-0.03)
Investment/GDP, PPP			-0.0191158 (-1.74)	-0.0220301 ** (-2.37)	-0.0175028 ** (-2.65)	-0.0161938 *** (-3.32)
Public expenditure/GDP, PPP			0.0018894 (0.51)	0.0017205 (0.53)	0.0028066 (0.89)	0.002951 (1.05)
Degree of democracy			0.0552345 (0.34)	0.0842936 (0.64)	0.1571238 (1.13)	0.2011153 * (1.76)
M2/GDP			0.0013088 (1.05)	0.0020883 * (1.86)	0.0002015 (0.21)	0.0006995 (0.82)
R squared	0.0816	0.1807	0.4780	0.5789	0.6341	0.6934
Adjusted R squared	0.0554	0.1573	0.2344	0.3824	0.4834	0.5672
Countries	37	37	23	23	25	25

Notes: t-values in parenthesis, *** stands for significant at 1% level, ** stands for significant at 5%, * stands for significant at 10%.
All the variables represent average values for each country for the period 1999-2002.

Table 6

In all the six specifications the proxies for altruism enter with a negative sign, suggesting that more altruistic countries tend to subsidise education less. Table 6 also shows that richer countries tend to subsidise education more than poorer countries even after controlling for altruism, though the effect tends to be statistically insignificant. The explanations for this can be diverse. Let us consider two possible explanations. First, the level of GDP may be related to the level of subsidies (or to other omitted variables that are correlated to subsidies) in ways not considered in this model. Second, the level of GDP may be correlated to altruism, and it may be picking up some of the effects of the ‘real altruism’ on subsidies not captured in our proxy *Altruism*. For this to be consistent, richer countries should be expected to be less altruistic. Previous research has also concluded that this should be expected (Laferrè and Wolff 2006, page 951; Arrondel and Masson 2006, page 1047), meaning that at least part of the positive relationship between GDP and subsidies could simply be a consequence of this. The data are consistent with the expectations of previous research: the simple correlation coefficient between GDP and altruism is -0.2676. Although this is far from conclusive, it suggests at least that ‘real altruism’ may be negatively correlated to GDP too (meaning that richer countries are less altruistic), so GDP in table 6 may be reflecting at least part of the effect of ‘real altruism’ not captured by the proxy used.

At the same time, this explanation is consistent with the data observed in figure 2: if more altruism translates into lower subsidies to education, and if richer countries tend to be less altruistic than poorer ones, then richer countries can be expected to subsidise education more than poorer ones.

Regarding the economic significance of the altruism coefficients, specification (4) of table 6 shows that if a country changes from ‘no altruistic’ to ‘altruistic’, the subsidy rate is expected to decrease by 13.3 percentage points (see coefficient of *Altruism Dummy*). Considering that the average subsidy of the sample is 0.8458 (84.58%), the estimated effect of altruism on

subsidies is economically relevant, as it represents a drop of 15.8% of the original value of subsidies. Using specification (3) of table 6 to assess the economic significance (where the proxy is *Altruism* instead of *Altruism Dummy*), a country starting with the average level of altruism (73.74; Poland is close to this value) that sees its altruism increased by a standard deviation (in this sample the standard deviation of altruism is 11.87) will, on average, see its subsidy rate dropping by 6.3 percentage points. This drop represents a drop of 7.4% of the original value of subsidies, which, again, looks economically relevant.

This relationship between altruism and subsidies is formalised in the next section, where I present a model that shows that lower levels of public education subsidies can be expected in countries with greater levels of private intergenerational altruism.

Model

This section presents a model that tries to explain what may be driving the relationship between altruism and the rate of subsidies to education.

a. Benchmark model

Individuals live two periods: in the first period they receive education, and in the second period they allocate their resources between consumption and their children's education.

An individual born in period $t-1$ will have the following utility function:

$$(1) \quad U_t = \theta \ln c_t + (1 - \theta) \ln h_t$$

where U_t stands for utility in period t ; c_t stands for consumption in period t and h_t stands for expenditure in the education of the individual's children. Equation (1) implies that individuals obtain utility from consuming and, altruistically, from educating their children. In equation (1), the degree of intergenerational altruism is represented by $(1-\theta)$, as it shows the effect that individuals' spending on their children's education has on utility. Bräuninger and Vidal (2000) use a similar function where altruism is reflected in a similar way (though they focus on growth rather than on the effect of altruism on subsidies).

Individuals have an initial wealth that is a proportion a of what their parents spent on their education during their first period of life. An individual born in period $t-1$ will receive education during period $t-1$, so his wealth in period t will be equal to ah_{t-1} .

Individuals allocate their wealth between consumption and education for their children. It is also assumed that the government imposes a lump sum tax equal to T to all individuals, and subsidises education expenditure at a rate ω . According to this, an individual born in $t-1$ will face the following budget constraint during period t :

$$(2) \quad ah_{t-1} - T_t = c_t + (1 - \omega)h_t$$

Saint-Paul and Verdier (1992) assume a relationship between h_t and h_{t-1} that is not very different from (2), though crucially, they do not focus on altruism so their analysis is conducted in another direction.

The left-hand side of (2) shows the total resources: initial wealth (ah_{t-1}) minus the lump sum tax. The right-hand side of (2) shows the use of the resources, which can be either spent on consumption or education. The fact that the expenditure on education is subsidised at a rate ω is reflected in

the factor $(1 - \omega)$. Individuals maximise (1) subject to (2). The optimal choices of this maximisation (the derivation is presented in appendix 5) are

$$(3) \quad h_t = \frac{(1 - \theta)}{1 - \omega} [ah_{t-1} - T_t]$$

$$(4) \quad c_t = \theta [ah_{t-1} - T_t]$$

b. The government

In order to be able to subsidise education with the revenues of the lump sum tax, the government faces the following budget constraint:

$$(5) \quad \sum_{i=1}^n T_{t,i} = \sum_{i=1}^n \omega h_{t,i}$$

which means that the sum of the lump sum taxes paid by all the individuals (thus the sum for individuals $i=1$ to n , where n is the total number of individuals) equals the sum of the total subsidies paid (thus the sum of ωh_t through individuals 1 to n). Assuming that all individuals are identical, expression (5) can be re-expressed as

$$(5') \quad T_t = \omega h_t$$

Inserting (5') in (3) and (4), the choices of the individuals maximising become

$$(6) \quad h_t = \frac{a(1 - \theta)}{1 - \omega\theta} h_{t-1}$$

$$(7) \quad c_t = \frac{a\theta(1 - \omega)}{1 - \omega\theta} h_{t-1}$$

From (6), growth depends positively on the level of subsidy:

$$(6') \quad \frac{h_t}{h_{t-1}} = \frac{a \cdot (1 - \theta)}{1 - \omega \theta}$$

which was an expected result. Additionally, (6) shows that the total expenditure on education (h_t) is positively related to the level of subsidies

$\left(\frac{\partial h_t}{\partial \omega} > 0 \right)$, while consumption is negatively related to the level of subsidies

$\left(\frac{\partial c_t}{\partial \omega} < 0 \right)$. Additionally, expression (8) below shows the effect of a change in

subsidies on individuals' expenditure on education ($h_t \cdot (1 - \omega)$).

$$(8) \quad \frac{\partial h_t \cdot (1 - \omega)}{\partial \omega} = a \cdot (1 - \theta) \cdot h_{t-1} \cdot \left[\frac{(1 - \omega) \cdot \theta}{(1 - \omega \theta)^2} - \frac{1}{1 - \omega \theta} \right] < 0$$

Expression (8) means that if the subsidies increase, individuals spend less on education²². This reveals that the subsidy 'crowds out' at least part of the individual's expenditure on education, which has an implication on the kind of altruism referred to here. From the utility function (1), individuals obtain utility from the total expenditure on their children's education regardless of who provides the resources (i.e. not just from their own expenditure on education). This, together with the 'crowding out' observed in (8) leads to the conclusion that the altruism observed here is not fully derived from a 'warm glow' effect (Andreoni 1989, 1990; Amegashie 2006) and that there is at least a component of 'pure' altruism. The utility that the parents obtain from their children's education does not solely depend on being

²² The expression in (8) is negative because the term in square brackets is negative, as shown here:

$$\frac{(1 - \omega) \cdot \theta}{(1 - \omega \theta)^2} < \frac{1}{1 - \omega \theta} \Rightarrow \frac{(1 - \omega) \cdot \theta}{(1 - \omega \theta)} < 1 \Rightarrow (1 - \omega) \cdot \theta < 1 - \omega \theta \Rightarrow \theta - \omega \theta < 1 - \omega \theta \Rightarrow \theta < 1$$

themselves (the parents) the ones who make the expenditure. If it did, then this would indicate a ‘warm glow’ effect. The result obtained here means that parents also obtain utility from the education received by their children that derives from subsidies, meaning that the parents’ altruism is ‘pure’ (Andreoni 1989, 1990; Amegashie 2006).

With (6) and (7), the original utility function can be re-expressed as

$$(9) \quad U_t = \theta \cdot \ln \left[\frac{a \cdot \theta (1 - \omega)}{1 - \omega \theta} \cdot h_{t-1} \right] + (1 - \theta) \cdot \ln \left[\frac{a \cdot (1 - \theta)}{1 - \omega \theta} \cdot h_{t-1} \right]$$

Re-arranging terms, this can be expressed as

$$(10) \quad U_t = \theta \cdot \ln(1 - \omega) - \ln(1 - \omega \theta) + \ln(a \cdot h_{t-1}) + \theta \ln(\theta) + (1 - \theta) \ln(1 - \theta)$$

To choose the rate of subsidies ω that maximises (10), the government calculates $\frac{\partial U}{\partial \omega}$, from where

$$(11) \quad \frac{\partial U}{\partial \omega} = -\frac{\theta}{1 - \omega} + \frac{\theta}{1 - \omega \theta}$$

The two terms on the right hand side of expression (11) represent the marginal cost and marginal benefit (respectively) of increasing subsidies: more subsidies decrease consumption $\left(\frac{\partial c_t}{\partial \omega} < 0 \right)$, which is a cost in terms of utility. But at the same time, more subsidies increase expenditure on education $\left(\frac{\partial h_t}{\partial \omega} > 0 \right)$. From (11) it is straightforward to see that as long as $0 < \theta < 1$, the marginal costs are greater (in absolute terms) than the marginal benefits²³. The

²³ Because $[(1 - \omega \theta) > (1 - \omega)]$

government, seeking to set the subsidy rate that maximises (9), is pushed to the corner solution $\omega = 0$.

Alternatively, if $\theta = 1$ then the government can choose any value in $0 < \omega < 1$. However, $\theta = 1$ is not consistent with the assumption of altruistic individuals that obtain utility from spending on their children's education (thus is not consistent with the utility function (1)). As a result, $\omega = 0$ appears as the government's choice to maximise utility.

c. Infinite horizons

This result only applies to a short-sighted government that does not weigh in the utility of future generations. If future generations are taken into account (in other words, if the government tries to maximise the intergenerational utility function), at $t=j$, the government's problem becomes

$$\text{Max}_{\omega} \sum_{t=j}^{\infty} \beta^{t-j} [\theta \cdot \ln(1 - \omega) - \ln(1 - \omega\theta) + \ln(a \cdot h_{t-1}) + \theta \ln(\theta) + (1 - \theta) \ln(1 - \theta)]$$

subject to $0 \leq \omega \leq 1$

The optimal choice of ω (the derivation is presented in appendix 6) is

$$(12) \quad \omega = \frac{\beta}{1 - \theta \cdot (1 - \beta)}$$

This result has the following implications.

First, ω increases with β :

$$(13) \quad \frac{\partial \omega}{\partial \beta} = \frac{1}{1 - \theta \cdot (1 - \beta)} - \frac{\beta \theta}{[1 - \theta \cdot (1 - \beta)]^2}$$

As expression (13) shows a positive derivative²⁴, governments that value the future more will subsidise education more than those that do not. This was an expected result: from (6), the rate of growth of education (thus, in this model, the rate of growth of the economy) depends positively on ω . As a result, considering that caring about the future requires caring about growth, more forward-looking governments will subsidise education more. In chapter 1 I argued that democratic governments can be expected to be more forward-looking than non-democratic ones. If that is the case, then this result could explain why democracies tend to devote more resources to education, while the previously observed result that richer countries devote more to public education could be a consequence of the positive relationship between income and democracy.

At one extreme, if the government values the future as much as the present ($\beta \rightarrow 1$), then (12) means that $\omega \rightarrow 1$, which is the maximum level of subsidy (100% subsidy). At the other extreme, a completely short-sighted government ($\beta = 0$) will set $\omega = 0$ according to (12)²⁵. This means that the more short-sighted the government, the lower the subsidies to education, and the lower the rate of growth of the economy. This result is robust to the modification of the initial model to include leisure (see appendix 7).

Second, ω increases with θ . This means that the more altruistic people are, the lower the subsidies to education will be. Intuitively, when people are altruistic enough to naturally spend on their children's education, there is no need for a government subsidy. However, if people are not

²⁴ Because $1 > \theta \Rightarrow 1 > \beta\theta + \theta(1 - \beta) \Rightarrow 1 - \theta(1 - \beta) - \beta\theta > 0 \Rightarrow$

$$\Rightarrow \frac{1}{1 - \theta(1 - \beta)} - \frac{\beta\theta}{[1 - \theta(1 - \beta)]^2} > 0 \Rightarrow \frac{\partial \omega}{\partial \beta} > 0$$

²⁵ This was an expected result, as the short-sighted model presented in (10) is only a special case of this infinite horizon model presented here, with $\beta = 0$.

altruistic at all, then the government will have to compensate for the lack of parents' efforts via subsidies.

Expression (12) means that in a totally altruistic society ($\theta \rightarrow 0$), the rate of subsidy will be $\omega \rightarrow \beta$. So the level of the subsidy rate will tend to the degree of 'forward-lookingness' of the government. On the other hand, in a totally non-altruistic society ($\theta \rightarrow 1$), the rate of subsidy will tend to $\omega \rightarrow 1$, meaning that if people obtain no utility from spending on their children's education, the government will have to subsidise all the education expenditure in order to maximise long-run utility. This is quite different from what was found in (10) (the static case): in that case, the government chose $\omega = 0$ regardless of the level of altruism.

In the model, the introduction of infinite horizons brought the emergence of positive subsidies. This means that with infinite horizons, when individuals obtain less value from intergenerational education (i.e. are less altruistic), the government has to subsidise education more heavily.

Conclusions

This chapter presents a model that intends to contribute towards the explanation of the differences in public expenditure on education across countries. This is done through the observation of one of the possible determinants of the rates of subsidy to the education expenditure of the households. The theoretical model predicts lower rates of public subsidies to education in countries that are more altruistic and that have high time discount rates (in other terms, countries that are more 'short-sighted').

I tested the implications related to the level of altruism. I do not claim that the degree of altruism *determines* the level of public subsidies to the education expenditure of the households; rather, I provide some evidence that

altruism can play a role among other variables. Altruism has an important national idiosyncratic component, which means that at least some part of the cross-country divergence in public involvement in education derives from factors that are exogenous to standard economic analysis.

Previous research explained why democracy and more public involvement in education go hand in hand (see for example Lipset 1959, Acemoglu and Robinson 2000, Acemoglu, Johnson, Robinson and Yared 2004, Gradstein, Justman and Meier 2005). With the model of this chapter to hand, future research should investigate whether variations in the level of altruism over time are in any way correlated with changing political institutions (in the sense of more or less democracy), which could elucidate whether the political regime affects public involvement in education through the channels investigated in this chapter. Kolm (2006) concludes that 'private giving' should be less evident in democracies than in non-democracies, and the dataset presented here seems to point in the same direction: the simple correlation coefficient between the measure of democracy that I use here and my measure of altruism is -0.2796. If both Kolm and this sample correlation are indeed correct, then the correlation between income and democracy (richer countries are more democratic, a standard result in the literature) could be translated into a positive relationship between income and education subsidies. The argument is as follows: richer countries are more democratic; more democratic countries are less altruistic; less altruism means more public subsidies to education; so richer countries subsidise education more. Although this is only a preliminary hypothesis for future research, tables 5 and 6 show that democracy tends to be positively related to expenditure on education, and the explanation of this relationship through altruism should be investigated in the future.

Although my main focus in this chapter is the effect of altruism on the rate of subsidies, I also conclude that greater discount rates (lower levels of β) translate into lower rates of subsidy. This factor could also feed the

relationship between income and education subsidies through democracy: in chapter 1 I presented some arguments of why we can expect dictatorships to have shorter time horizons than democracies. If that is the case, then the correlation between richer countries and democracies could translate into a correlation between richer countries and lower discount rates (greater levels of β), which means that richer countries should see greater rates of subsidy (which is consistent with the evidence presented in figure 1). This causal chain is also a preliminary hypothesis for future research (appendix 8 adds more evidence towards this hypothesis).

This chapter provides the first proxies for cross-country altruism and cross-country education subsidies in the literature. Both proxies are far from ideal, and for that reason future research should focus on producing more appropriate measures of these variables in the form of time series, and particularly on altruism, which looks like a promising factor to understand how countries form their education budgets.

Appendix 1: Data for figure 2

Countries included: Argentina; Australia; Austria; Belgium; Canada; Chile; China; Czech Republic; Denmark; Finland; France; Germany; Greece; Iceland; India; Indonesia; Ireland; Israel; Italy; Jamaica; Japan; Jordan; Korea; Rep.; Luxembourg; Malaysia; Mexico; Netherlands; New Zealand; Norway; Paraguay; Peru; Philippines; Poland; Portugal; Slovak Republic; Spain; Sri Lanka; Sweden; Switzerland; Thailand; Turkey; United Kingdom; United States; Uruguay.

Descriptive statistics:

Averages 1996-2002		
	Pub expend educ / Total expend educ	GDP per capita, PPP
Countries	44	44
Mean	0.82	17026.06
Standard Deviation	0.14	10166.25

Appendix 2: Sources of data.

(Altruism and Subsidies are explained in the text)

GDP per capita: GDP per capita in constant US\$ (year 2000). Source: World Bank, World Development Indicators (WDI) April 2008, ESIDS International, (Mimas) University of Manchester.

GDP per capita, PPP: Penn World Table. Source: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006.

Growth of GDP per capita, PPP: Constructed using the previous variable, and expressed in decimals (0.01 instead of 1%). For table 6, I built this variable using the first and last available data on GDP per capita (PPP) for each country, and annualising the results.

Public expenditure/GDP, PPP: World Penn Table. Source: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006. Expressed in percentage points (1% instead of 0.01).

Public expenditure/GDP: World Penn Table. Source: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006. This institution kindly

provided the 'no PPP adjusted' version of this variable. Expressed in percentage points (1% instead of 0.01).

Investment/GDP: World Penn Table. Source: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006. This institution kindly provided the 'no PPP adjusted' version of this variable. Expressed in percentage points (1% instead of 0.01).

Investment/GDP, PPP: World Penn Table. Source: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006. Expressed in percentage points (1% instead of 0.01).

Public education expenditure/GDP: Source: World Bank, World Development Indicators (WDI) April 2008, ESDS International, (Mimas) University of Manchester. Expressed in percentage points (1% instead of 0.01).

Degree of democracy: Measures the degree of institutionalised democracy from 0 to 1 (where higher numbers mean more democracy). This variable is a linear transformation of the variable 'Polity' from the Polity IV database, which ranges from -10 to 10. Source: Monty G. Marshall and Keith Jaggers. 2004. Polity IV Data Set. [Computer file; version p4v2004] College Park, MD: Center for International Development and Conflict Management, University of Maryland.

Trade/GDP, PPP: Sum of exports and imports of goods and services measured as a share of gross domestic product. Source: World Penn Table. Source: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006. Expressed in percentage points (1% instead of 0.01).

Trade/GDP: Sum of exports and imports of goods and services measured as a share of gross domestic product. Source: World Penn Table. Source: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006. This institution kindly provided the 'no PPP adjusted' version of this variable. Expressed in percentage points (1% instead of 0.01).

Population 15-64 years/Total population: Percentage of the total population that is in the age group 15 to 64. Source: World Bank, World Development Indicators (WDI) April 2008, ESDS International, (Mimas) University of Manchester. Expressed in percentage points (1% instead of 0.01).

Population 0-14 years/Total population: Percentage of the total population that is in the age group 15 to 64. Source: World Bank, World Development Indicators (WDI) April 2008, ESDS International, (Mimas) University of Manchester. Expressed in percentage points (1% instead of 0.01).

M2/GDP: Ratio of Money and quasi money (M2) as a share of GDP. Source: World Bank, World Development Indicators (WDI) April 2008, ESDS International, (Mimas) University of Manchester. Expressed in percentage points (1% instead of 0.01).

Appendix 3: Data for table 5

Countries common to all the specifications: Albania; Argentina; Armenia; Australia; Azerbaijan; Bangladesh; Belarus; Benin; Bhutan; Bolivia; Botswana; Brazil; Bulgaria; Burundi; Cambodia; Cameroon; Canada; Chad; Chile; China; Colombia; Comoros; Congo (Rep.); Costa Rica; Croatia; Cyprus; Czech Republic; Denmark; Dominican Republic; Ecuador; El Salvador; Equatorial Guinea; Eritrea; Estonia; Ethiopia; Fiji; Gabon; Georgia; Ghana; Guinea; Guinea-Bissau; Hungary; India; Indonesia; Iran Islamic Rep.; Israel; Ivory Coast; Jamaica; Japan; Jordan; Kazakhstan; Kenya; Korea (Rep.); Kuwait; Kyrgyz Republic; Lao PDR; Latvia; Lesotho; Lithuania; Macedonia (FYR); Madagascar; Malawi; Malaysia; Mali; Mauritania; Mauritius; Mexico; Moldova; Mongolia; Morocco; Mozambique; Namibia; Nepal; New Zealand; Nicaragua; Niger; Norway; Oman; Pakistan; Panama; Paraguay; Peru; Philippines; Poland; Romania; Russian Federation; Rwanda; Saudi Arabia; Senegal; Sierra Leone; Singapore; Slovak Republic; Slovenia; Solomon Islands; South Africa; Swaziland; Sweden; Switzerland; Tajikistan; Tanzania; Thailand; The Gambia; Togo; Trinidad and Tobago; Tunisia; Turkey; Uganda; Ukraine; United Arab Emirates; United States; Uruguay; Yemen (Rep.); Zambia; Zimbabwe.

Countries added for specification 2: Austria; Bahamas; Belgium; Belize; Cape Verde; Finland; France; Germany; Greece; Iceland; Ireland; Italy; Lebanon; Luxembourg; Maldives; Malta; Micronesia; Fed. Sts.; Netherlands; Portugal;

Samoa; Serbia and Montenegro; Spain; St. Lucia; St. Vincent and the Grenadines; Tonga; United Kingdom; Vanuatu

Countries added for specification 3: Angola; Guyana; Libya

Countries added for specification 4: Angola; Austria; Belgium; Cuba; Finland; France; Germany; Greece; Guyana; Ireland; Italy; Libya; Netherlands; Portugal; Spain; United Kingdom

Descriptive statistics: each of the four regressions in table 4 includes different sets of countries due to the different availability of data and the different variables included in each regression. For that reason, the statistics provided below are calculated for the pool of 182 countries from which the subset for each regression was obtained.

Averages for 1999-2002	Mean	Standard Deviation	Min	Max
Degree of Democracy	0.649	0.326	0.00	1.00
GDP per capita, constant prices	5772.5	9002.6	86.36	46345.8
GDP per capita, PPP	8674.0	9025.9	363.62	47450.0
Investment/GDP	22.350	8.627	3.61	53.07
Investment/GDP, PPP	13.458	7.792	1.70	45.28
M2/GDP	44.928	32.150	4.20	187.25
Population 0-14 years/Total population	32.544	10.462	14.26	50.31
Population 15-64 years/Total population	60.648	6.666	47.08	74.62
Public education expenditure /GDP	4.663	2.079	0.61	15.36
Public expenditure /GDP	16.706	8.147	3.67	80.71
Public expenditure /GDP, PPP	23.972	11.434	2.84	76.21
Trade/GDP	86.776	47.052	2.02	368.94
Trade/GDP, PPP	88.418	48.908	2.02	373.55

Appendix 4: Data for table 6

Countries common to all the specifications: Argentina; Australia; Canada; Chile; China; Czech Republic; Denmark; India; Indonesia; Japan; Jordan; Mexico; New Zealand; Norway; Peru; Philippines; Poland; Slovak Republic; Sweden; Switzerland; Turkey; United States; Uruguay.

Countries added for specifications 1 and 2: Austria; Belgium; Finland; France; Germany; Greece; Iceland; Ireland; Italy; Luxembourg; Netherlands; Portugal; Spain; United Kingdom.

Countries added for specifications 5 and 6: Hungary; Korea (Rep.).

Descriptive statistics: the regressions in table 6 include 3 different sets of countries due to the different availability of data and the different variables included in each regression. For that reason, the statistics provided below are calculated for the pool of 39 countries from which the subset for each regression was obtained. The mean of the altruism dummy is not equal to 0.5 because the median was taken from a sample of 79 countries (full 'altruism' sample) to get a wider altruism standard for the median. However, the statistics presented here are only for the countries included in the regression.

Averages for 1999-2002	Mean	Standard Deviation	Min	Max
Subsidies	0.85	0.108	0.53	1.0
Subsidies-Extended	0.82	0.12	0.53	1.0
Altruism	71.09	10.69	41.60	90.3
Altruism dummy	0.359	0.48	0.00	1.0
GDP per capita, PPP	16914	9284	2319	41034
Trade/GDP, PPP	72.4	42.9	18.0	240.8
Investment/GDP, PPP	21.11	4.80	11.34	37.83
Public expenditure/GDP, PPP	19.71	7.67	8.58	50.69
Degree of democracy	0.90	0.20	0.15	1.0
M2/GDP	57.6	27.5	23.4	128.7

Appendix 5: The individual's maximisation problem

$$(a5.1) \quad \text{Max}_{h_t, c_t} U_t = \theta \ln c_t + (1 - \theta) \ln h_t$$

$$\text{Subject to } ah_{t-1} - T_t = c_t + (1 - \omega)h_t$$

The budget constraint can be re-expressed as $c_t = ah_{t-1} - T_t - (1 - \omega)h_t$, which can be then re-inserted in the objective function to obtain

$$(a5.2) \quad \text{Max } U_t = \theta \ln[ah_{t-1} - T_t - (1 - \omega)h_t] + (1 - \theta) \ln h_t$$

Setting $\frac{\partial U_t}{\partial h_t} = 0$ yields

$$(a5.3) \quad \frac{-\theta(1 - \omega)}{ah_{t-1} - T_t - (1 - \omega)h_t} + \frac{(1 - \theta)}{h_t} = 0$$

Rearranging,

$$(a5.4) \quad h_t = \frac{(1 - \theta)}{1 - \omega} [ah_{t-1} - T_t]$$

Inserting this into $c_t = ah_{t-1} - T_t - (1 - \omega)h_t$ yields

$$(a5.5) \quad c_t = \theta [ah_{t-1} - T_t]$$

Expressions (a5.4) and (a5.5) are maximums: this can be seen by calculating the second derivative of the utility function with regards to h_t . Using the first derivative presented in (a5.3), this becomes

$$(a5.6) \quad \frac{-\theta(1 - \omega)^2}{(ah_{t-1} - T_t - (1 - \omega)h_t)^2} - \frac{(1 - \theta)}{h_t^2} < 0$$

Appendix 6: Derivation of the long-sighted government's optimal subsidy rate

(a6.1) Max_{ω}

$$\sum_{t=j}^{\infty} \beta^{t-j} [\theta \cdot \ln(1 - \omega) - \ln(1 - \omega\theta) + \ln(a \cdot h_{t-1}) + \theta \ln(\theta) + (1 - \theta) \ln(1 - \theta)]$$

I first rename $R = \ln(a) + \theta \ln(\theta) + (1 - \theta) \ln(1 - \theta)$, so (a6.1) can be re-expressed as

$$(a6.2) \quad Max_{\omega} \sum_{t=j}^{\infty} \beta^{t-j} [\theta \cdot \ln(1 - \omega) - \ln(1 - \omega\theta) + \ln(h_{t-1}) + R]$$

which can then be re-expressed as

$$(a6.3) \quad Max_{\omega} \frac{\theta \cdot \ln(1 - \omega) - \ln(1 - \omega\theta)}{1 - \beta} + \frac{R}{1 - \beta} + \sum_{t=j}^{\infty} \beta^{t-j} [\ln(h_{t-1})]$$

The term $\sum_{t=j}^{\infty} \beta^{t-j} [\ln(h_{t-1})]$ can be re-expressed as

$$(a6.4) \quad \sum_{t=j}^{\infty} \beta^{t-j} [\ln(h_{t-1})] = \ln(h_{t-1}) + \beta \ln(h_t) + \beta^2 \ln(h_{t+1}) + \beta^3 \ln(h_{t+2}) + \dots$$

Using expression (6), each of the terms of (a6.4) can be re-expressed in terms of h_{t-1} :

$$(a6.5) \quad \sum_{t=j}^{\infty} \beta^{t-j} [\ln(h_{t-1})] =$$

$$\ln(h_{t-1}) + \beta \ln\left(h_{t-1} \cdot \frac{a(1 - \theta)}{1 - \omega\theta}\right) + \beta^2 \ln\left(h_{t-1} \cdot \left(\frac{a(1 - \theta)}{1 - \omega\theta}\right)^2\right) + \beta^3 \ln\left(h_{t-1} \cdot \left(\frac{a(1 - \theta)}{1 - \omega\theta}\right)^3\right) + \dots$$

from where



$$(a6.6) \sum_{i=j}^{\infty} \beta^{i-j} [\ln(h_{t-1})] =$$

$$\frac{\ln(h_{t-1})}{1-\beta} + \beta \ln\left(\frac{a(1-\theta)}{1-\omega\theta}\right) + \beta^2 \ln\left(\frac{a(1-\theta)}{1-\omega\theta}\right)^2 + \beta^3 \ln\left(\frac{a(1-\theta)}{1-\omega\theta}\right)^3 + \dots$$

Taking common factor $\ln\left(\frac{a(1-\theta)}{1-\omega\theta}\right)$, this becomes

$$(a6.7) \sum_{i=j}^{\infty} \beta^{i-j} [\ln(h_{t-1})] = \frac{\ln(h_{t-1})}{1-\beta} + \ln\left(\frac{a(1-\theta)}{1-\omega\theta}\right) [\beta + 2\beta^2 + 3\beta^3 + \dots]$$

I call $S = [\beta + 2\beta^2 + 3\beta^3 + \dots]$, then $\beta S = [\beta^2 + 2\beta^3 + 3\beta^4 + \dots]$, so

$$S - \beta S = [\beta + \beta^2 + \beta^3 + \dots] = \frac{1}{1-\beta} - 1. \text{ So } S \cdot (1-\beta) = \frac{\beta}{1-\beta}, \text{ from where}$$

$$S = \frac{\beta}{(1-\beta)^2}.$$

This means that (a6.7) can be re-expressed as

$$(a6.8) \sum_{i=j}^{\infty} \beta^{i-j} [\ln(h_{t-1})] = \frac{\ln(h_{t-1})}{1-\beta} + \ln\left(\frac{a(1-\theta)}{1-\omega\theta}\right) \cdot \frac{\beta}{(1-\beta)^2}$$

Inserting this result back in (a6.3) yields

$$(a6.9) \text{Max}_{\omega} \frac{\theta \cdot \ln(1-\omega) - \ln(1-\omega\theta)}{1-\beta} + \frac{R}{1-\beta} + \frac{\ln(h_{t-1})}{1-\beta} + \frac{\beta}{(1-\beta)^2} \cdot \ln\left(\frac{a(1-\theta)}{1-\omega\theta}\right)$$

from where

$$(a6.10) \text{Max}_{\omega}$$

$$\frac{\theta \cdot \ln(1-\omega) - \ln(1-\omega\theta)}{1-\beta} + \frac{R}{1-\beta} + \frac{\ln(h_{t-1})}{1-\beta} + \frac{\beta}{(1-\beta)^2} \cdot \ln(a(1-\theta)) - \frac{\beta}{(1-\beta)^2} \cdot \ln(1-\omega\theta)$$

I now name $J = \frac{R}{1-\beta} + \frac{\beta}{(1-\beta)^2} \cdot \ln(a(1-\theta))$

so (a6.10) becomes

$$(a6.11) \quad \text{Max}_{\omega} \frac{\theta \cdot \ln(1-\omega) - \ln(1-\omega\theta)}{1-\beta} + \frac{\ln(h_{t-1})}{1-\beta} - \frac{\beta}{(1-\beta)^2} \cdot \ln(1-\omega\theta) + J$$

This expression can now be simplified to

$$(a6.12) \quad \text{Max}_{\omega} \frac{\theta \cdot \ln(1-\omega)}{1-\beta} - \ln(1-\omega\theta) \cdot \left(\frac{\beta}{(1-\beta)^2} + \frac{1}{1-\beta} \right) + \frac{\ln(h_{t-1})}{1-\beta} + J$$

or

$$(a6.13) \quad \text{Max}_{\omega} \frac{\theta \cdot \ln(1-\omega)}{1-\beta} - \ln(1-\omega\theta) \cdot \left(\frac{1}{(1-\beta)^2} \right) + \frac{\ln(h_{t-1})}{1-\beta} + J$$

Now I search the maximum by differentiating (a6.13) with respect to ω and making the result equal to zero, from where

$$(a6.14) \quad \frac{\theta}{1-\beta} \cdot \frac{-1}{1-\omega} + \left(\frac{1}{(1-\beta)^2} \right) \cdot \left(\frac{\theta}{1-\omega\theta} \right) = 0$$

So

$$(a6.15) \quad \left(\frac{1}{(1-\omega\theta) \cdot (1-\beta)} \right) = \left(\frac{1}{1-\omega} \right)$$

from where

$$(a6.16) \quad \omega = \frac{\beta}{1-\theta \cdot (1-\beta)}$$

I now have to determine whether this is a maximum or a minimum.
 For this, I take the second order derivative of (a6.13):

$$(a6.17) \frac{\partial^2 U_i}{\partial^2 \omega} = \left(\frac{\theta}{1-\beta} \right) \left[\frac{-1}{(1-\omega)^2} + \frac{\theta}{1-\beta} \cdot \frac{1}{(1-\omega\theta)^2} \right]$$

Whether (a6.17) is positive or negative depends on whether the square bracket is positive or negative. In other words, the question is whether

$$(a6.18) \left[\frac{-1}{(1-\omega)^2} + \frac{\theta}{1-\beta} \cdot \frac{1}{(1-\omega\theta)^2} \right] >< 0$$

Rearranging, this becomes

$$(a6.19) (\theta - 1 + \beta) >< (\omega\theta)(\omega\theta + 2\beta - \beta\omega\theta - \omega)$$

Now I substitute ω with the optimal value found in (a6.16),

$$\omega = \frac{\beta}{1-\theta.(1-\beta)}, \text{ obtaining}$$

$$(a6.20)$$

$$(\theta - 1 + \beta) >< \left(\theta \cdot \frac{\beta}{1-\theta.(1-\beta)} \right) \left(\theta \cdot \frac{\beta}{1-\theta.(1-\beta)} + 2\beta - \beta\theta \frac{\beta}{1-\theta.(1-\beta)} - \frac{\beta}{1-\theta.(1-\beta)} \right)$$

from where

$$(a6.21) (\theta - 1 + \beta) >< \left(\theta \cdot \frac{\beta^2}{1-\theta.(1-\beta)} \right) \left(\frac{\theta - \beta\theta - 1}{1-\theta.(1-\beta)} + 2 \right)$$

Operating and rearranging, this can be expressed as

$$(a6.22) -\theta^2 + 2\theta - 1 >< 0$$

Expression (a6.22) is never greater than zero: it is a parable with negative concavity, with a maximum at $\theta=1$. In that maximum, $-\theta^2 + 2\theta - 1 = 0$.

This means that at the optimal ω , the objective function has a negative second order derivative, except at $\theta=1$, where the second order derivative equals zero. This means that for $0 \leq \theta < 1$, the optimal ω found is a maximum. When $\theta=1$, then $\omega=1$. This is a corner solution. The first derivative of the utility function in terms of ω is positive when $\omega=1$, meaning that if $\theta=1$, the corner solution $\omega=1$ gives maximum utility. However, as I argued before, $\theta=1$ is not consistent with the assumption of altruistic individuals that obtain utility from spending on their children's education (thus is not consistent with the utility function (1)).

Appendix 7: An extension including leisure

The utility function to be maximised is

$$(a7.1) \quad U_t = \theta_1 \ln C_t + \theta_2 \ln(1 - \alpha_t) + (1 - \theta_1 - \theta_2) \ln h_t$$

where α_t is time spent on education and $(1 - \alpha_t)$ is leisure time. The time spent on education affects the education rate of return 'a'.

The individual's budget constraint is

$$(a7.2) \quad C_t + (1 - \omega)h_t = ah_{t-1} - T_t$$

Substituting the budget constraint in the utility function

$$(a7.3) \quad U_t = \theta_1 \ln[ah_{t-1} - T_t - (1 - \omega)h_t] + \theta_2 \ln(1 - \alpha_t) + (1 - \theta_1 - \theta_2) \ln h_t$$

Maximising in terms of α_t :

$$(a7.4) \quad \frac{\partial U_t}{\partial \alpha_t} = 0 \Rightarrow \frac{\theta_1 a' h_{t-1}}{ah_{t-1} - T_t - (1 - \omega)h_t} - \frac{\theta_2}{1 - \alpha} = 0$$

Then setting $\frac{\partial U_t}{\partial h_t} = 0$ gives

$$(a7.5) \quad h_t = \frac{(1 - \theta_1 - \theta_2)}{(1 - \omega)(1 - \theta_2)} [ah_{t-1} - T_t]$$

and

$$(a7.6) \quad C_t = \frac{\theta_1}{(1 - \theta_2)} [ah_{t-1} - T_t]$$

Substituting the government's budget constraint ($T_t = \omega h_t$) in (a7.4), (a7.5) and (a7.6) I get

$$(a7.7) \quad \frac{\theta_1 a' h_{t-1}}{ah_{t-1} - \omega h_t - (1-\omega)h_t} - \frac{\theta_2}{1-\alpha} = 0$$

$$(a7.8) \quad h_t = ah_{t-1} \cdot \frac{(1-\theta_1-\theta_2)}{(1-\theta_2-\omega\theta_1)}$$

$$(a7.9) \quad C_t = ah_{t-1} \cdot \theta_1 \cdot \frac{(1-\omega)}{(1-\theta_2-\omega\theta_1)}$$

From (a7.8), $\frac{h_t}{h_{t-1}} = a \cdot \frac{(1-\theta_1-\theta_2)}{(1-\theta_2-\omega\theta_1)}$, so higher levels of subsidy yield higher rates of growth. This was an expected result.

Inserting (a7.8) in (a7.7), h_{t-1} cancels out, giving

$$(a7.10) \quad (1-\alpha_t) = \left(\frac{a\theta_2}{a'} \right) \cdot \frac{(1-\omega)}{(1-\theta_2-\omega\theta_1)}$$

Assuming $a = \alpha^\mu$ with $0 < \mu < 1$, I obtain

$$(a7.11) \quad \alpha = \frac{\mu(1-\theta_2-\theta_1 \cdot \omega)}{\mu(1-\theta_2-\theta_1 \cdot \omega) + \theta_2 \cdot (1-\omega)}$$

From this expression, I obtain

$$(a7.12) \quad \frac{\partial \alpha}{\partial \omega} = \frac{\theta_2 \cdot \mu \cdot (1-\theta_2-\theta_1)}{[\mu \cdot (1-\theta_2-\omega\theta_1) + \theta_2 \cdot (1-\omega)]^2}$$

From this expression, $\frac{\partial \alpha}{\partial \omega} > 0$, which was an expected result: more subsidy to education means that individuals will be willing to work more.

Expression (a7.11), together with (a7.8) and (a7.9) should now be substituted back in to (a7.1) to solve for ω for the short-sighted government.

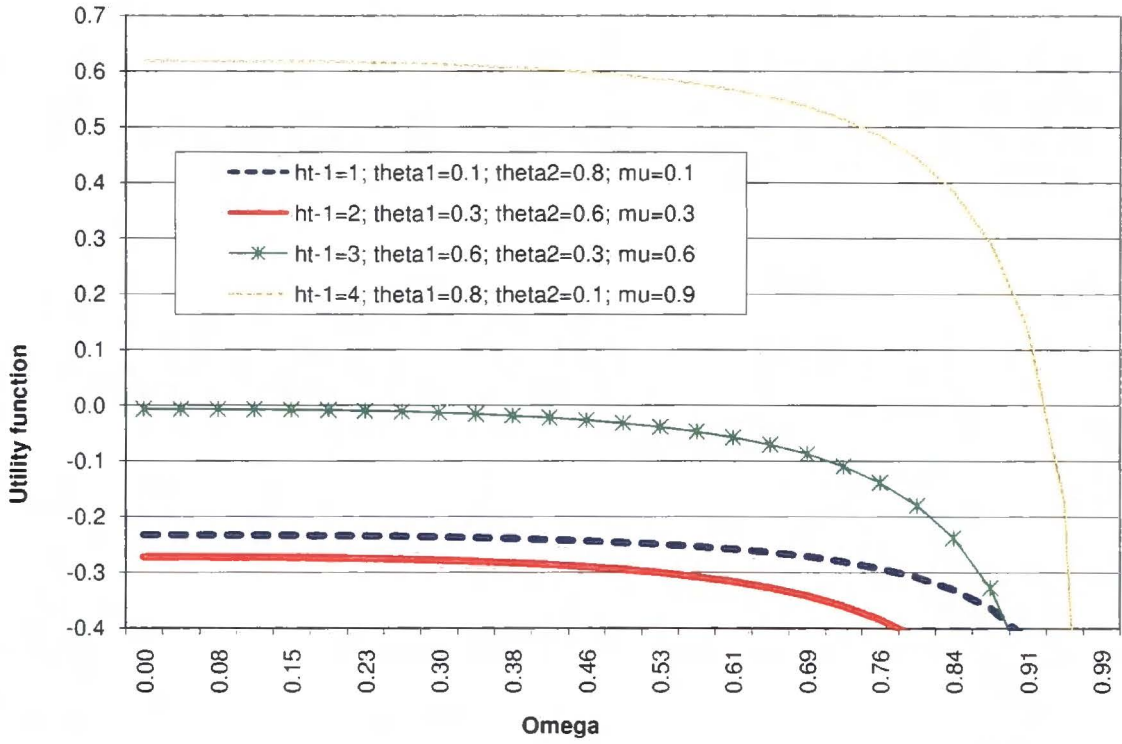
The utility function becomes

$$(a7.13) \quad U_t = \theta_1 \ln \left[ah_{t-1} \cdot \theta_1 \cdot \frac{(1-\omega)}{(1-\theta_2 - \omega\theta_1)} \right] + \theta_2 \ln \left[1 - \frac{\mu(1-\theta_2 - \theta_1 \cdot \omega)}{\mu(1-\theta_2 - \theta_1 \cdot \omega) + \theta_2 \cdot (1-\omega)} \right] + (1-\theta_1 - \theta_2) \ln \left[ah_{t-1} \cdot \frac{(1-\theta_1 - \theta_2)}{(1-\theta_2 - \omega\theta_1)} \right]$$

For the short-sighted government I compute $\frac{\partial U_t}{\partial \omega} = 0$ and try to solve for ω . However, I cannot obtain a clean expression for ω , so I resort to simulation. A simulation exercise for different values of $\theta_1, \theta_2, h_{t-1}$ and μ yields a maximum utility for $\omega = 0$, which is the same result obtained for a short-sighted government in the benchmark model.

Figure a7.1 shows the results of the simulation exercise.

Figure a7.1



For the long-sighted government I compute $\sum_{t=0}^{\infty} \beta^t U_t$, where U_t is given

by (a7.13).

The long-sighted government will then choose the level of subsidies that maximises

$$(a7.14) \quad \sum_{t=0}^{\infty} \beta^t U_t = \frac{\theta_1 \ln \left[a \cdot \theta_1 \cdot \frac{(1-\omega)}{(1-\theta_2 - \omega\theta_1)} \right] + \theta_2 \ln \left[1 - \frac{\mu(1-\theta_2 - \theta_1 \cdot \omega)}{\mu(1-\theta_2 - \theta_1 \cdot \omega) + \theta_2 \cdot (1-\omega)} \right]}{1-\beta} +$$

$$+ \frac{(1-\theta_1 - \theta_2) \ln \left[a \cdot \frac{(1-\theta_1 - \theta_2)}{(1-\theta_2 - \omega\theta_1)} \right]}{1-\beta} + (1-\theta_2) \cdot \left[\frac{\ln(h_{t-1})}{1-\beta} + \ln \left(\frac{a \cdot (1-\theta_1 - \theta_2)}{(1-\omega\theta_1 - \theta_2)} \right) \cdot \frac{\beta}{(1-\beta)^2} \right]$$

(where the last term is obtained in a way similar to (a6.8)).

Again, setting $\frac{\partial U_t}{\partial \omega} = 0$ does not allow for a clean expression for ω , so I resort to simulation. A simulation exercise for different values of θ_1, θ_2 and β shows that utility is maximised for $\omega > 0$, which is the same result obtained for a long-sighted government without leisure. Additionally, the simulation shows that increasing altruism tends to decrease the optimal level of subsidies, while increasing β (increasing 'long-sightedness') increases the optimal level of subsidies. These results are consistent with those obtained for the long-sighted model without leisure. Table a7.1 shows selected results of the simulation.

Table a7.1

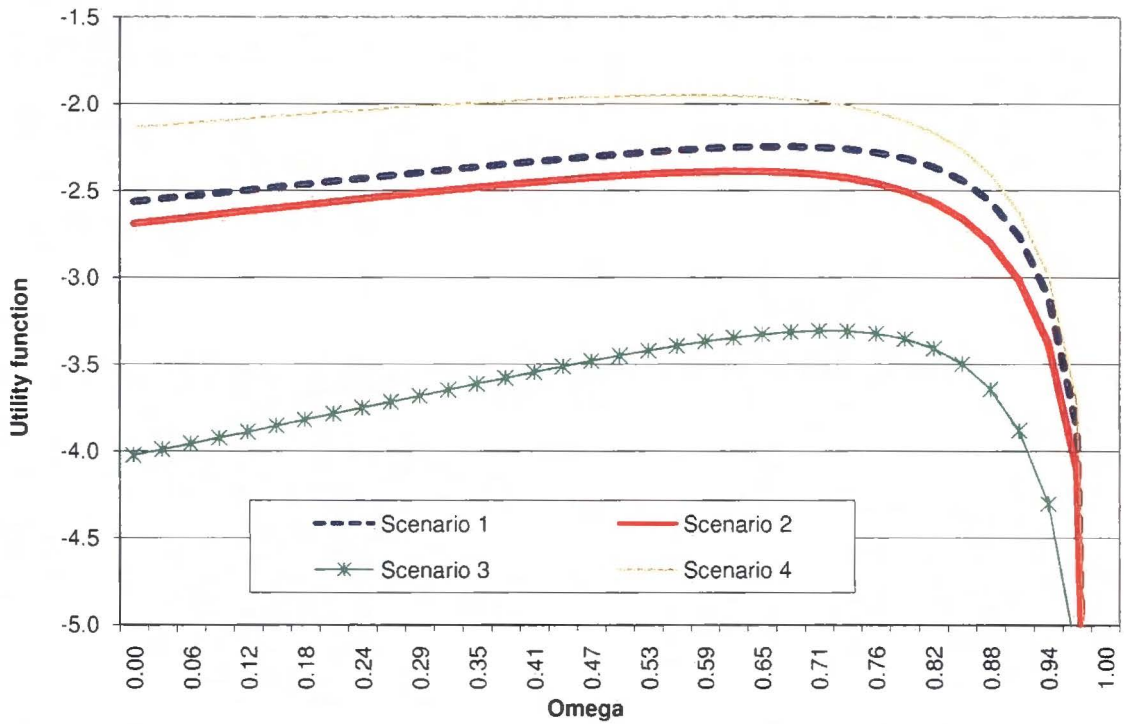
Scenarios:	1	2	3	4
θ_1	0.2	0.2	0.2	0.1
θ_2	0.6	0.5	0.5	0.6
β	0.5	0.5	0.6	0.5
μ	0.5	0.5	0.5	0.5
h_{t-1}	1	1	1	1
Optimal ω	0.667	0.625	0.714	0.571

In table a7.1, the movement from scenario 1 to scenario 2 reduces θ_2 , which means that leisure loses weight in the determination of utility, but altruism increases (altruism equals $(1 - \theta_1 - \theta_2)$ in this model). As can be seen, the optimal subsidy decreases from 0.667 to 0.625. To check whether the reduction in the optimal subsidy is due to the increase in altruism or the decrease in the weight of leisure, scenario 4 reduces θ_1 and leaves θ_2 constant (compared to scenario 1). This means that the increase in altruism is due to a reduction in the weight of consumption in utility. The result is again the same:

a reduction in the optimal subsidy rate, suggesting that again, more altruism means a lower subsidy rate.

The movement from scenario 2 to scenario 3 changes only β , trying to capture the effect of an increase in the ‘long-sightedness’ of the government. Table a7.1 shows that this increase in β (a reduction in the discount rate) translates into an increase in the optimal subsidy rate, from 0.625 to 0.714. Again, this result is consistent with the results obtained for a long-sighted government without subsidy. Figure a7.2 shows a graphical representation of some of the results of the simulation.

Figure a7.2



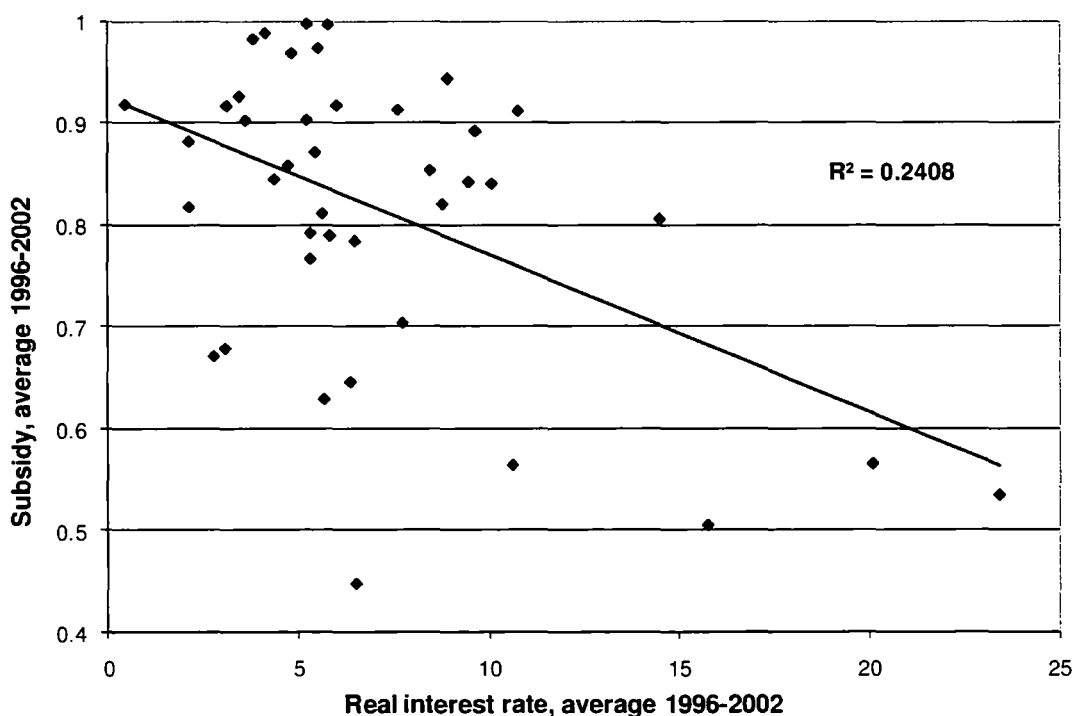
Appendix 8: Social discount rates, subsidies and level of income

One of the reasons why I do not investigate the relationship further between social discount rate and the rate of subsidies is the lack of appropriate proxies for the social discount rate for a sufficient number of countries.

In this appendix I use data on the average real interest rate for 1996-2002 (World Bank, World Development Indicators (WDI) April 2008, ESDS International, (Mimas) University of Manchester) to proxy for the social discount rate.

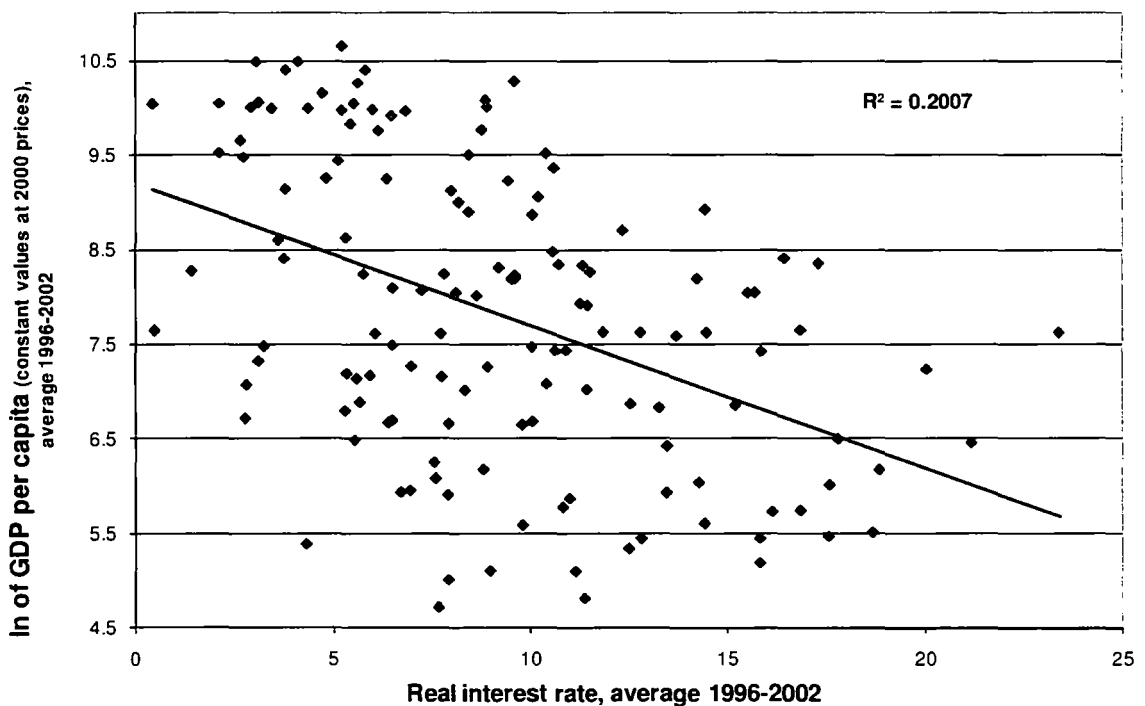
Figure 8.1 shows some preliminary evidence in favour of the relationship found in the model: countries with higher interest rates (lower β) tend to have lower rates of subsidy to education. The figure shows data for 42 countries, which excludes 1 outlier.

Figure 8.1



In the conclusion of this chapter I argue that the relationship between income and education subsidies could run through democracy: in chapter 1 I presented some arguments to illustrate why we can expect dictatorships to have shorter time horizons than democracies. If that is the case, then the correlation between richer countries and democracies could translate into a correlation between richer countries and lower discount rates (greater levels of β), which means that richer countries should see greater rates of subsidy. Figure 8.2 provides some preliminary evidence in this direction with data for 137 countries, which excludes 14 outliers and 5 countries that showed negative real rates of interest (though in principle there should be no reason to exclude these 5 countries, it is difficult to argue that a negative real rate of interest could be reflecting a negative social discount rate).

Figure 8.2



In any case, regardless of the considerations on democracy and dictatorship, the relationship of figure 8.2 is consistent with the evidence of richer countries spending more resources on education: if richer countries tend to have lower social discount rates, then the model of this chapter shows why these lower discount rates are translated to lower rates of education subsidy.

Chapter 3

Bounded dictators: education and regime transitions

Abstract

By looking at the effect of education expenditure on income, the model of this chapter explains why dictators have an incentive to distort the effects of education on economic growth, and why democracies need income redistribution policies. I analyse the permanence of dictatorship and emergence of democracy by looking at two constraints faced by dictators. First, dictators need soldiers for protection but also need people to work and pay taxes. This creates a trade-off between spending on defence or in education (which in turn increases wealth and tax revenues). Second, the individuals who are worse-off due to the extortive powers of the dictator are willing to pay to reduce the size of the army that protects the dictator, which limits the dictator's extortive powers.

Introduction

Research focused on the effects of political institutions on the budgetary allocations found some variations in how democracies and non-democracies allocate resources to education and the military. In particular, the evidence suggests that non-democracies tend to spend more in the military whereas democracies tend to increase social expenditure (including education).

Lebovic (2001) observes the yearly change in the budget shares of military and 'civilian' (all non-military) expenditure for a set of Latin American countries during the regional wave of democratization between 1974 and 1995. The author finds that the level of democracy is positively associated with increases in the share of civilian expenditure after controlling for a set of budgetary and extra-budgetary variables, and concludes that democracy "*has a significant positive effect on the size of non-military relative to military budgets*" (Lebovic 2001, page 427).

Mulligan, Gil and Sala-i-Martin (2004) find that non-democracies spend more on the military. Their interpretation is that non-democracies are interested in setting policies that make it more difficult for the opposition to gain office, and this is why they find significant changes in military spending and policies on torture and freedom of the press. However, they do not find significant evidence that non-democracies have different priorities than democracies regarding educational expenditure. They interpret this result saying that education does not have a direct effect on the probability of losing office, so dictators do not have an incentive to modify expenditure in education. They observe a set of 131 countries over 1960-1990 and regress the share of different spending categories on the level of democracy (using the measure of democracy derived from Polity IV, which I use in Chapter 4; see Chapter 1 for a description of this variable) and a set of controls.

Habibi (1994) finds that the defence budget increases in non-democracies, but finds that social expenditure (which includes education, health and social security) is higher in democracies than in non-democracies. In some of the specifications he uses, the level of democracy becomes significant to explain education expenditure in itself (not aggregated with other non-military categories of expenditure). His observation is for 1984 and includes 67 developed and developing countries of different regions of the world.

Glaeser, Ponzetto and Shleifer (2006) address this point. They provide arguments for why education and democracy should be correlated, and then ask:

“why do some dictators invest in education if they know that doing so eventually dooms them? [...]. There are several possible answers. One is that many dictators face an external threat, and therefore must grow their economies and their armies (including investing in human capital) to counter these threats even if this raises the risk of democratization. A second is that even selfish dictators unconcerned with external threats might derive income from economic growth, and therefore promote education to get richer. A third [...] idea is that all dictators face significant risks, and that it is much better for the dictator’s life for him to be replaced by a democracy in an educated country than by another dictator in an uneducated one.” (Glaeser, Ponzetto and Shleifer 2006, page 32).

This seems to suggest that there are opposing interests: while a dictator obtains some benefits from spending in the military, it is also true that some benefits can be identified from spending on education. Additionally, taking these two categories alone, there are opportunity costs of one category in terms of the other. All this suggests that there are some trade-offs to be

explained and that can be helpful in understanding how dictators make their budgetary decisions on defence and education.

Acemoglu (2003), Acemoglu and Robinson (2000, 2002 and 2006), Robinson (1999), Bourguignon and Verdier (2000) and Glaeser, Ponzetto and Shleifer (2006) refer to the educational trade-off faced by dictators: if they educate the population, the economy can grow faster and they can benefit from that (for example, through the extraction of more resources). On the other hand, a more educated and richer population poses a bigger threat to the ruling dictator. In this sense, the dictator will not devote as many resources to education as his democratic counterpart.

Acemoglu and Robinson (2000, 2006) claim that at first the dictator can offer some small transfers and benefits to the masses (like public education) in order to keep them satisfied and under control. But transfers can be instated and later removed, according to the will of the dictator and to the threats he perceives, so the population knows that public education can be transitorily provided to the masses as a way to avoid revolutions. During periods of acute unrest and when people can overcome the collective action costs (for example, because education could bring the collective action costs down), the power of the dictator is challenged beyond the limits that transitory concessions and transfers can reach. In those situations, the authors claim that the most cost-effective option for the dictator is to transfer more than money: the dictator has to transfer political power to the masses, which means that the dictator does not have the capacity to stop transfers and benefits in the future. Therefore, the extension of the franchise is a strategy to avoid revolutions against the dictator, who prefers to lose power slowly (extending democracy) rather than to violently lose everything. The new political institutions generate changes in economic institutions, which will favour the newly enfranchised population, who may use democracy to tilt economic institutions and the income distribution in their favour, for instance, through extending public education.

A crucial difference between this chapter and the work of Bourguignon and Verdier (2000) is that they put the decision to extend the political rights in the hands of the elite (in this case, the dictator). In their model the elite decide whether to provide public education (the poor are liquidity-constrained and cannot afford education by themselves), and they also assume that only the educated have political rights. In terms of the relationship between education and democracy, this amounts to assuming causality from education to democracy. Therefore, when the elite decide to extend public education, they are also deciding to share power with the newly educated. However, the elite may decide to do this because they benefit from the positive externalities of a more educated population, so they have to compare the benefits they obtain from the positive externalities with two sets of costs: directly, the costs of the transfers needed to educate the poor; indirectly, the costs associated with the probability that once educated, the newly enfranchised individuals may vote for more transfers from the rich to the poor. Faced with these benefits and costs, the elite may decide to educate only a number of poor that will not change the voting majority, so that the elite maintain the political power but at the same time can benefit from the educational externalities. This favours the appearance of the middle class, and at the same time reduces the growth rate that would be observable if all the poor received education.

Similarly, Acemoglu and Robinson (2006) put the final decision to democratise in the hands of the dictator: they assume that repression always succeeds, so the dictator can always deter democratising threats through repression. Ultimately, the dictator compares the costs and benefits of repression and democracy and then decides to choose either repression or democracy. In contrast, the model of this chapter allows for transitions to democracy to either be caused by the dictator himself or to be promoted from the citizenry. This, I understand, provides a more realistic approach.

Additionally, in the model of this chapter, one of the critical factors that limit the ability of the dictator to maintain democracy has to do with the

effect that education expenditure has on income: the greater the effect of education expenditure on income, the more difficult it is for the dictator to maintain dictatorship. This, to the best of my knowledge, has not been incorporated before.

The model presented in chapter 3 of this thesis does not initially assume that educated individuals earn more than soldiers or informal workers (this is later removed when analysing the effects of the transfers on income distribution). This differs from Acemoglu and Robinson (2006) or Bourguignon and Verdier (2000), who assume that there are 'rich' and 'poor' individuals, but for whom the rich are the 'ruling elite' and the poor are the citizenry. So while I assume that there is only one dictator and that the citizenry is divided between educated and non-educated (with potentially different levels of income between those two groups), Acemoglu and Robinson (2006) assume that there is a 'ruling elite' with a level of income higher than that of the rest of the citizens (who all earn the same). However, the most important difference between this model and that of Acemoglu and Robinson (2006) is that in their case, income does not depend on education expenditure, whereas in this model, education expenditure has a central role (and is the determinant of the level of income of the educated population).

The model of Acemoglu and Robinson (2006) is oriented in a different way to the model presented here: for example, they observe the effect of income distribution on the transitions to democracy, which is something I do not do in this model. One of the features incorporated by Acemoglu and Robinson (2006) is what they call the 'cost of revolution' (μ in their model), which reflects the fraction of total income that is lost in a democratising revolution due to the economic disruption generated. The citizenry, before starting a revolution, compare that cost of the revolution with the benefits they can obtain (the share of income that during a dictatorship is held by the ruling elite, represented by θ in their model). In the model of this chapter, the concept of μ is partly reflected in the level of transfers T , as they represent the cost that

has to be paid (by the educated individuals) to obtain democracy. On the other hand, the benefits of democracy (the θ of Acemoglu and Robinson 2006) are here derived from two different factors: (i) the cessation of the dictatorial taxes paid by the educated individuals during dictatorship (having them removed in democracy is a benefit for them); and (ii) the increase in income during democracy that results from more resources being directed to education. Also, other benefits of democracy include the transfers that some non-educated individuals receive from the educated ones, though those benefits are not taken into consideration by those who ultimately promote the transition to democracy (the educated individuals, who promote the transitions, do not see the benefits of the transfers received by the non-educated; on the contrary, those transfers are costs for educated individuals).

In the second section I set up a model; in the third section I determine the maximum level of dictatorial taxes; in the fourth section I characterise the demand for soldiers; the fifth section describes the transitions to democracy; in the sixth section I introduce a dynamic version of the model and analyse the variation of corruption; in the seventh section I conclude.

Setup of the static model

A dictator lives one period, at the beginning of which he has to decide how to spend his budget of one monetary unit given that his options are public education and defence. Public education is initially assumed to increase output, while defence increases his probability of not being overthrown by the people; in other words, the probability of *no* democratising revolution. If the dictator is not overthrown by a revolution, he will be able to seize a fraction t (taxes) of the output of the economy, while if there is a revolution, I initially assume that he will not be able to seize anything. These taxes are not ‘normal’ taxes but ‘dictatorial taxes’, that is, extractions by the dictator to increase his

personal wealth. In this sense, those taxes reflect the extractive power of the dictator as such.

The available budget of 1 monetary unit does not depend on the taxes t , because the budget of 1 monetary unit is fixed, whereas the taxes t are the dictator's extraction for his own benefit and do not feed back into the public budget. For clarity, it can be assumed that the money that the dictator extracts through taxes goes to his private bank account abroad, and does not enter the circuit of the public finances.

I assume that all the expenditure in defence is used to hire soldiers, so total expenditure in defence equals the wage of a soldier (w) times the number of soldiers (n). Note that n refers to the 'dictatorial soldiers', that is, not the 'usual' soldiers during times of peace and democracy, but to the soldiers that the dictator hires to protect his dictatorship. Given that the dictator has only one monetary unit to allocate and that the only options are defence or education, the resources that go to education are $(1-w.n)$. This direct trade-off between education and defence represents a simplification of the budgetary trade-offs discussed in the introduction of this chapter (for example Lebovic 2001 and Habibi 1994).

The wage rate w is given exogenously to the dictator at the level $w=w^*$, as the dictator is himself a relatively small employer in the economy. The wage rate is determined in the informal labour market, which cannot be taxed by the dictator due to high monitoring costs²⁶.

²⁶ The fact that the dictator pays the soldiers a wage equal to the market wage means that the dictator cannot simply force the uneducated individuals to work for his defence. This could rest in two assumptions: (i) the uneducated individuals in the informal sector are difficult to reach by the government, something that is consistent with the idea of an underground or informal economy in itself. In consequence, publicly offering a market wage rate is the way to attract these individuals. (ii) If uneducated individuals are forced to work for free, they will not be committed to their job and their productivity will be close to zero. For example, an individual that is *forced* to work in the army will not be willing to risk his life to defend the

Individuals can become soldiers and receive the wage rate $w=w^*$, or can receive education and produce output (those individuals are said to be in the education/production sector), or can work in the informal sector (which does not require education) at the wage rate w^* without being taxed. Consequently, the total population N is divided among educated individuals (U), soldiers (n) (who are uneducated), and informal workers (X) (who are also uneducated). I assume that the total population N is fixed, and so is U , so the dictator can only recruit from the pool of uneducated individuals ($X+n$).

Total public expenditure on education ($1-w.n$) affects the level of production and income of the individuals in the education/production sector, so each of them produces more when public expenditure in education is higher. However, there is no mobility in or out of the educated sector: soldiers and informal workers cannot enter the education/production sector (nor can educated individuals become informal workers or soldiers), though there is perfect mobility among soldiers and informal workers (because both groups are formed by uneducated individuals).

I refer to the output produced by each individual in the education/production sector as y , which is assumed to increase with $(1-w.n)$ but with no increasing returns to scale: doubling the expenditure on education does not more than double output per worker (the second derivative of output on education expenditure, y'' , is nonpositive). If no money goes to education, output per worker in the education/production sector is assumed to be zero: $y(0)=0$. This income function means that all of the educated individuals earn the same income (because public education expenditure is the same for all), and all the non-educated earn the same (because soldiers are paid the wage of the informal sector). However, I do not assume a priori that educated

dictator, so the dictator will not be getting any real protection at all. Therefore, the dictator pays the soldiers the market wage to get an army of individuals who will willingly provide all the protection they can. When they do so, the 'defence function' is p , as described below.

individuals earn more than soldiers or informal workers (while Acemoglu and Robinson (2006) do that, see above)

I assume that the probability of no democratising revolution (or probability of dictatorial peace) increases linearly with the proportion of soldiers in the total population, such that $p = \frac{n}{N}$. Therefore, the smaller the number of soldiers, the less likely it is that the dictatorship will persist. I also assume that given N , there is a fixed level of soldiers \bar{n} below which revolutions cannot be avoided. This means that p is defined as

$$(1) \quad p = \begin{cases} 0 & \text{if } n < \bar{n} \\ \frac{n}{N} & \text{if } n \geq \bar{n} \end{cases}$$

Individuals in the education/production sector are the only ones that pay the dictatorial taxes t . Given that they are the only ones paying the cost of the dictatorship, they are also willing to pay to end the regime and force a transition to democracy. For that reason, they will offer transfers to the soldiers if they do not protect the dictator, so that \bar{n} is not reached and the dictatorship collapses. The higher the taxes t extracted by the dictator, the higher the cost faced by the educated individuals, so they will be prepared to pay higher transfers in order to avoid dictatorship. This means that the dictator cannot freely increase t : as t increases, the educated individuals will offer greater incentives to the uneducated individuals in order to persuade them not to join the army.

This model does not incorporate voting mechanisms, so considerations like the extension of the franchise (as in Saint-Paul and Verdier 1993 or Bourguignon and Verdier 2000) are deliberately ignored.

Dictatorial Taxes

In this section I determine how much the educated individuals will be willing to transfer to the uneducated individuals in order to persuade them not to join the army and therefore avoid dictatorship, and how this limits the taxing powers of the dictator.

According to the defence technology described above, the dictator may be able to avoid democracy only if $n \geq \bar{n}$. This means that his budget of 1 monetary unit will be enough to reach a positive level of expected income if $w^* \cdot \bar{n} \leq 1$. If $w^* \cdot \bar{n} > 1$ (or if $w^* > \frac{1}{\bar{n}}$), then the dictator cannot hire the minimum number of soldiers and dictatorship has probability $p=0$. Note that both w^* and \bar{n} are given for the dictator, so he may just be unable to avoid democracy with his budget of 1 monetary unit.

This means that the educated individuals can offer a transfer T to the would-be soldiers so that

$$(2) \quad w^* + T > \frac{1}{\bar{n}}$$

in which case democracy is unavoidable. The transfer that makes democracy unavoidable is then

$$(3) \quad T > \frac{1}{\bar{n}} - w^* \Rightarrow T = \frac{1}{\bar{n}} - w^* + \alpha$$

where $\alpha \rightarrow 0^+$.

This transfer T does not have to be paid to all the uneducated individuals (potential soldiers). To avoid dictatorship, the transfer has to be paid to a number of uneducated individuals such that there are not enough uneducated individuals left to be employed as soldiers. From the uneducated

population $(N-U)$, the dictator needs \bar{n} individuals in the army to have a chance to maintain his power. This means that if $(N-U-\bar{n})$ individuals receive the transfer, the dictator will at most be able to hire exactly \bar{n} soldiers and have a chance to keep dictatorship. If, however, the educated individuals pay the transfer to $(N-U-\bar{n}+\varepsilon)$ individuals (where $\varepsilon \rightarrow 0^+$), then the dictator will not be able to employ the necessary \bar{n} individuals and dictatorship will collapse.

The total amount of transfers that the educated individuals will have to pay to secure democracy is then

$$(4) \quad T.(N-U-\bar{n}+\varepsilon)$$

So each educated individual will have to pay

$$(5) \quad \frac{T.(N-U-\bar{n}+\varepsilon)}{U}$$

Educated individuals will be willing to pay the amount (5) for democracy only if their net income in democracy is greater than their net income in dictatorship.

I defined above the net income of an educated individual in dictatorship as $y.(1-t)$. I now denote the level of income of an educated individual in democracy with g . The difference between y and g is only that in democracy there is no money going to a dictatorial army, so $w.n=0$. For this reason, $g=y(1)$, that is, the income an individual gets in democracy is the same that he would get if the dictator devotes all the resources to education and nothing to defence. If income were insensitive to education expenditure, then $y=g$. Here I assume that income does increase with education expenditure, so $g>y$. According to this notation and to (5), if educated individuals transfer money to the uneducated in order to promote democracy, then the net income of an educated individual in democracy becomes

$$(6) \quad g - \frac{T.(N-U-\bar{n}+\varepsilon)}{U}$$

Educated individuals will prefer democracy to dictatorship as long as the net income in democracy exceeds the net income in dictatorship:

$$(7) \quad g - \frac{T.(N-U-\bar{n}+\varepsilon)}{U} > y.(1-t)$$

Rearranging (7) can be re-expressed as

$$(8) \quad t > 1 - \frac{1}{y} \left[g - \frac{T.(N-U-\bar{n}+\varepsilon)}{U} \right]$$

If (8) applies, the educated individuals will be able to offer transfers to the non-educated individuals, such that not enough of them will be willing to protect the dictator, making the dictatorship collapse.

Expression (8) shows that the greater the income in democracy (g) compared to that of dictatorship (y), the lower t must be to avoid democracy. If education has a great impact on the income of the educated individuals, the ratio $\frac{g}{y}$ increases, which means that democracy is very rewarding for educated individuals. According to (8), this means that educated individuals will be willing to offer more to promote a transition towards democracy. The dictator will be willing to set a tax rate beyond the limit of (8) only if he makes sure that he can decrease $\frac{g}{y}$. This is of crucial relevance for the implications of this model and will be discussed further below.

From (8), the dictator can only influence t (a policy variable) and y (which depends on the number of soldiers he hires). The rest of the variables are given for the dictator. For that reason, I denote

$$(9) \quad z = \left[g - \frac{T \cdot (N - U - \bar{n} + \varepsilon)}{U} \right]$$

so (8) becomes

$$(8') \quad t > 1 - \frac{z}{y}$$

Note that z is fixed and does not change with any policy variable, as all the variables on the right hand side of (9) are fixed. From (8'), the maximum tax rate that the dictator can set is

$$(10) \quad t = 1 - \frac{z}{y}$$

Any tax rate greater than (10) will fall in the boundaries defined by (8'), which means that transfers offered by the educated individuals produce a transition to democracy. In fact, if (10) applies, educated individuals are indifferent between democracy and dictatorship, so I assume that the dictator can keep his dictatorship.

The next section deals with the other variable that the dictator can influence in (10): the number of soldiers (n) and through it, the value of y . But the value of y also affects t (so n affects t), so when the dictator chooses n , he is also setting y and the highest possible level of taxes.

Demand for soldiers

Total income in the formal sector will be equal to the income per educated worker times the educated population (the population in the education/production sector). The educated population is U , so total formal income is $y \cdot U$, a portion t of which is the dictator's tax extraction. However,

this will only be available to the dictator in case of dictatorship, which has probability p .

According to this, the expected income of the dictator ($E(D)$) is

$$(11) \quad E(D) = p \cdot y \cdot U \cdot t$$

Considering the wage w , the dictator needs to choose the number of soldiers to be employed (n) that maximizes his expected total income, given that he has only one monetary unit to spend and that the maximum tax rate that he can set is given by (10).

As he hires more soldiers, the probability of no revolution (p) increases and he secures his expected income (so (11) increases). However, hiring more soldiers at the ongoing wage rate decreases the resources that can be allocated to education, so y decreases, which reduces (11). A decreasing y also means that the right hand side of (10) falls, which means that the maximum level of taxes that the dictator can set decreases, which also decreases (11). All this raises a series of interesting trade-offs.

Expression (11) shows that for any given value of n , the income of the dictator increases with the level of taxes. In other words, for any level of n the dictator chooses the highest possible tax rate, which is given by (10). Also, for dictatorship to persist, the condition $n \geq \bar{n}$ has to be satisfied, so $p = \frac{n}{N}$. Inserting this and (10) (the highest possible tax rate) in expression (11), the income of the dictator can be expressed as

$$(12) \quad E(D) = \frac{n}{N} \cdot y \cdot U \cdot \left[1 - \frac{z}{y} \right] = \frac{U}{N} \cdot [n \cdot y - n \cdot z]$$

If an interior solution exists, to choose the optimal number of soldiers to hire the dictator sets

$$(13) \quad \frac{\partial E(D)}{\partial n} = \frac{U}{N} \cdot [y - w.n.y' - z] = 0$$

from where n is such that

$$(14) \quad n = \frac{y(1 - wn) - z}{w.y'(1 - wn)}$$

The existence of an interior solution requires the following second order condition to be satisfied:

$$(15) \quad \frac{\partial E(D)}{\partial^2 n} = \frac{U}{N} \cdot (-2.w.y' + n.w^2.y'') < 0$$

The right hand side of (15) is always negative ($2.w.y'$ is always positive, whereas y'' was assumed nonpositive), so (15) stands.

An interior solution means that the dictator employs: (i) fewer soldiers than the total uneducated population, and (ii) at least the minimum number of soldiers (\bar{n}). Requirement (i) is consistent with the assumption that the dictator is a price taker in the labour market (w^* is given for the dictator). If he employed all the uneducated individuals, he would be a monopsonist and his decision would influence the wage rate. The total uneducated labour force is ($N-U$), so the first requirement of the interior solution means that expression (13) has to be negative when evaluated at ($N-U$):

$$(16) \quad \left. \frac{\partial E(D)}{\partial n} \right|_{n=N-U} = \frac{U}{N} \cdot [y - w.n.y' - z] \Big|_{n=N-U} < 0$$

Requirement (ii) means that expression (14) applies for n such that $\frac{y(1 - wn) - z}{w.y'(1 - wn)} \geq \bar{n}$. Instead, if n is such that $\frac{y(1 - wn) - z}{w.y'(1 - wn)} < \bar{n}$, then the dictator is in a corner, and will either face a revolution ($n < \bar{n}$ means $p=0$, in which case his income becomes 0) or hire \bar{n} soldiers at the market wage rate. He will

only be able to do this if $w\bar{n} \leq 1$ (his total budget equals 1). Summarising, the dictator's demand for soldiers is

$$(17) \left\{ \begin{array}{l} \text{If } \frac{y-z}{y'.w} \geq \bar{n} \rightarrow \text{Interior solution: } n = \frac{y-z}{y'.w} \quad (a) \\ \text{If } \frac{y-z}{y'.w} < \bar{n} \rightarrow \text{Corner } \left\{ \begin{array}{l} \text{If } w\bar{n} < 1 \rightarrow n = \bar{n} \quad (b) \\ \text{If } w\bar{n} = 1 \rightarrow \text{dictator indifferent} \\ \text{between } n = \bar{n} \text{ and } n=0 \quad (c) \\ \text{If } w\bar{n} > 1 \rightarrow n = 0 \quad (d) \end{array} \right. \end{array} \right.$$

In case (a), the dictator can reach an interior solution following (13).

In case (b), the dictator is in a corner, but at least he can afford to hire enough soldiers to get a positive expected income.

In case (c) the dictator has the option to use his entire budget in the army and stop the revolution (in which case $(1-wn)=0$, so $y=0$), or to hire less than the minimum required number of soldiers and face a revolution. In both cases his income is zero, so he is indifferent between both scenarios.

In case (d) the dictator cannot afford to hire enough soldiers to stop a democratising revolution.

Demand depends negatively on g according to (14) and ((17) (a)) (because z depends positively on g). The reason for this is that if the payoff of education is high (so g is high compared to y) then the educated individuals will be willing to pay more to end dictatorship. To avoid this, the dictator tries

to increase the value of dictatorship for the educated individuals via a higher y , which requires a lower n .

Comparative statics

Changes in the market wage rate (which is given exogenously to the dictator) give place to changes in the optimal n to be chosen by the dictator. Here I find how the optimal choice of n changes when the wage rate changes.

For values of $\frac{y-z}{y'.w} \geq \bar{n}$ (when case (a) applies in (17)), expression

(13) can be re-expressed as

$$(18) \quad f(n, w) = y - w.n.y' - z = 0$$

Therefore,

$$(19) \quad \frac{\partial n}{\partial w} = - \frac{\frac{\partial f}{\partial w}}{\frac{\partial f}{\partial n}}$$

Given that f represents the first order condition in n , then the denominator of (19) is nothing else than the second order condition expressed in (15), which is negative. In consequence, the sign of (19) depends on the sign of $\frac{\partial f}{\partial w}$.

$$(20) \quad \frac{\partial f}{\partial w} = -y'.n - n.y' + n^2.w.y'' = -2.y'.n + n^2.w.y''$$

Considering that $2.y'.n$ is positive and that y'' is nonpositive, then expression (20) is negative. This means that numerator and denominator of (19) are negative, so (19) (which is preceded by a negative sign) is negative. In

fact, a negative relationship between n and w should have been expected since I am analysing the demand for soldiers: when soldiers are more expensive, the dictator will demand fewer soldiers.

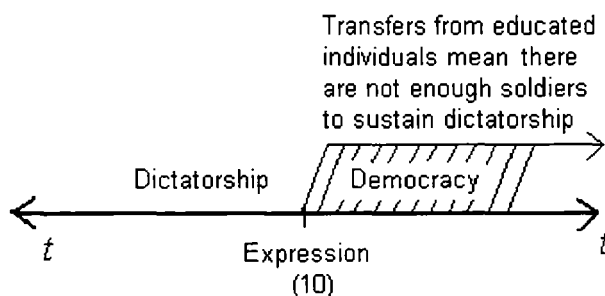
For values of $\frac{y-z}{y' \cdot w} < \bar{n}$ (cases (b), (c) or (d) apply in (17)), changes in w mean that either n remains at $n = \bar{n}$ (if (b) applies to the new value of w), or a revolution arises and $n=0$ (if (d) applies to the new value of w). If (c) applies to the new value of w , the dictator is indifferent and either $n = \bar{n}$ or $n=0$ is possible.

Transitions to democracy

Expression (10) shows the maximum level of taxes that the dictator can set. It is particularly relevant to note that the dictator is not an unconstrained agent: dictatorship can give place to democracy (or vice-versa) depending on whether condition (8) holds or not. Therefore, even though the dictator has all the political power, his extractive powers are constrained, and that is a key implication of this model.

Figure 1 represents the tax space for democracy and dictatorship.

Figure 1



For (10) to be achievable in dictatorship, (10) has to be positive (otherwise dictatorship requires a negative tax rate). This depends on the size of the impact of education expenditure on income: if $\frac{g}{y}$ is too large (i.e. if the impact on income of an additional education expenditure of $w.n$ monetary units is too large), the dictator cannot set positive taxes (according to (10)), so dictatorship gives place to democracy. In particular, if the income of an educated individual in democracy is much higher than that of an educated individual in dictatorship (so $\frac{g}{y}$ becomes higher, which means that the extra $w.n$ spent on education have a great effect on income), the educated individuals in democracy are able to transfer enough money to the soldiers to stop dictatorship.

All this means that dictatorships require that the level of income achievable in democracy by an educated individual is not much higher than the level of income achievable in dictatorship by an educated individual. A low $\frac{g}{y}$ means that the additional resources that would go to education in the case of a transition from dictatorship to democracy ($w.n$) will have a low impact on income.

For this reason, the dictator has an incentive to blur the effects of education on income during periods of dictatorship (he cannot do anything during democracy), so that the educated individuals perceive a lower $\frac{g}{y}$ during dictatorships and do not offer credible transfers to the uneducated individuals. In other words, it is to the dictator's advantage if education does not appear to be the path towards growth in dictatorship. If for whatever reason (some hypothesis are presented in the next chapter) the effect of

education on income is different on democracies and non-democracies, then the ratio $\frac{g}{y}$ will be perceived differently from each regime.

According to this model, transitions from dictatorship to democracy can be triggered by transfers from educated individuals to non-educated individuals. If educated individuals earn more than non-educated individuals, as assumed by Acemoglu and Robinson (2006) or Bourguignon and Verdier (2000) (and a point on which there seems to be a consensus; see Psacharopoulos 1993, Psacharopoulos and Patrinos 2002, Griliches and Mason 1972 among many others), in democracies one should expect more transfers from the rich to the poor than in non-democracies.

Also according to this model, the educated individuals will offer transfers only if they earn a larger net income in democracy than in dictatorship; in other words, they will promote a transition to democracy if their income in democracy (net of transfers paid to the uneducated) is greater than their income in dictatorship (net of dictatorial taxes). In consequence, the income of the educated also goes up in a transfer-promoted democracy, so the total effect of a transition from dictatorship towards democracy on income distribution depends on the value of some of the parameters (see appendix 1).

However, the finding that democracies should have more redistributive policies in place transferring income from the educated to the non-educated (loosely, from the rich to the poor) is consistent with the arguments of Acemoglu and Robinson (2000), Acemoglu and Robinson (2006) and Bourguignon and Verdier (2000), who expect that democracies will have more redistributive tendencies than non-democracies. In fact, in Bourguignon and Verdier (2000) the democracies are by definition more redistributive (or more redistributive systems are by definition more democratic), because the more the richer transfer resources for the poor's education, the more extended is democracy.

Appendix 2 presents an example of this model using a linear function for $y(1-wn)$, where $y(1-wn)=1-wn$.

A dynamic model

In this section, I modify some of the assumptions made so far and extend the model to a dynamic framework with an infinite horizon. I also reassess the choices of the different agents. In the use of notation and in the presentation of equations, I try to follow Acemoglu and Robinson (2006). However, I argued above that their model is oriented in a different way to the model presented here: they observe the effect of income distribution on the transitions to democracy, which is something I do not do in this model. But also, the model that I present here puts emphasis on the transitions to democracy that can be promoted by the educated individuals, whereas Acemoglu and Robinson (2006) put the final decision to democratise in the hands of the dictator.

For each of the three agents identified in the previous sections (dictator, educated individuals, and soldiers) I define V_r^i as the return to an individual of type i starting in the regime r . The types of individual will be represented by d, e, s , meaning dictator, educated individuals, and soldiers respectively, and the regime r will be represented by DIC and DEM , meaning dictatorship and democracy. Democracy (state DEM) occurs with probability $(1-p)$ while dictatorship occurs with probability (p) . I assume that p is constant whatever the current state, so the probability of a dictatorial coup in democracy equals the probability of remaining in dictatorship.

In state DIC , individual $i = \hat{i}$ has an income of x per period. As a result, the value function for individual \hat{i} starting in an initial state DIC becomes:

$$(21) \quad V_{DIC}^i = x + \beta \left[p.V_{DIC}^i + (1-p).V_{DEM}^i \right]$$

where I am using the discount factor β (with $0 < \beta < 1$). Expression (21) says that the value to individual \hat{i} in dictatorship consists of what happens today (first term x) plus what is expected to happen tomorrow (continuation value), represented by the term $\beta \left[p.V_{DIC}^i + (1-p).V_{DEM}^i \right]$. Analogously, assuming that in state *DEM* individual \hat{i} has an income of k , the value function of individual \hat{i} starting in an initial state *DEM* is:

$$(22) \quad V_{DEM}^i = k + \beta \left[p.V_{DIC}^i + (1-p).V_{DEM}^i \right]$$

Using this initial setup, I analyse the value functions of each of the three types of agents, and from there I try to understand how democracy and dictatorship interact.

Dictator

As shown in the previous sections, in a period of dictatorship the income of the dictator equals $y.U.t$. Note that this expression is not premultiplied by 'p' because I am considering the dictator's revenue in a period of actual dictatorship, so as dictatorship is already settled during this initial period his present revenue is $y.U.t$ with probability 1. However, the state may change in the future, so the value function of the dictator starting in dictatorship becomes

$$(23) \quad V_{DIC}^d = y.U.t + \beta \left[p.V_{DIC}^d + (1-p).V_{DEM}^d \right]$$

from where

$$(24) \quad V_{DIC}^d = \frac{y \cdot U \cdot t + \beta(1-p) \cdot V_{DEM}^d}{1 - \beta p}$$

Note that if there is complete certainty that dictatorship will continue in the future (so $p=1$), expression (24) becomes

$$(25) \quad V_{DIC}^d = \frac{y \cdot U \cdot t}{1 - \beta}$$

Expression (25) shows that if there is complete certainty that dictatorship will continue, the value of dictatorship for a dictator equals the sum of the infinite discounted revenues. On the other hand, if there is complete certainty that democracy will arise (so $p=0$), then expression (24) becomes

$$(26) \quad V_{DIC}^d = y \cdot U \cdot t + \beta V_{DEM}^d$$

This expression means that the dictator will obtain the revenues of this period (where the state is dictatorship) and from next period onwards he will get the payoffs of democracy. The setup of this model assumes that the same individual dictator is reappointed if democracy reverts to dictatorship in the future. Although this is exceptional in terms of historical evidence, I am using Acemoglu and Robinson's (2006) approach, which assumes a dictatorship that is led by a ruling elite. In this case, it does not need to be the same individual dictator who is reappointed, but the same elite or oligarchy.

Regarding the value for the dictator starting in democracy, I now assume that during democracy, the dictator earns an income of \hat{g} . For example, the dictator can lead a peaceful transition to democracy and becomes an educated individual, in which case his income in democracy is $\hat{g} = g$. In this scenario, (22) becomes

$$(27) \quad V_{DEM}^d = \hat{g} + \beta [p \cdot V_{DIC}^d + (1-p) \cdot V_{DEM}^d]$$

from where

$$(28) \quad V_{DEM}^d = \frac{\hat{g} + \beta p \cdot V_{DIC}^d}{1 - \beta(1 - p)}$$

Inserting (28) in (24),

$$(29) \quad V_{DIC}^d = \frac{y \cdot U \cdot t \cdot [1 - \beta(1 - p)] + \hat{g} \cdot \beta \cdot (1 - p)}{1 - \beta}$$

Re-inserting (29) into (28)²⁷,

$$(30) \quad V_{DEM}^d = \hat{g} + \beta \cdot \frac{\hat{g} \cdot (1 - p) + y \cdot U \cdot t \cdot p}{1 - \beta}$$

With (29) and (30) I determine under which circumstances the dictator will prefer dictatorship to democracy and vice versa. The dictator will prefer dictatorship to democracy as long as $V_{DIC}^d \geq V_{DEM}^d$ (where I am assuming that if $V_{DIC}^d = V_{DEM}^d$, he chooses dictatorship). From (29) and (30),

$$(31) \quad V_{DIC}^d \geq V_{DEM}^d \Rightarrow y \cdot U \cdot t \geq \hat{g} \text{ }^{28}$$

If, as stated above, the dictator can lead a peaceful transition to democracy and get an income of $\hat{g} = g$ in democracy, then (31) shows that the dictator chooses between dictatorship and democracy depending on whether the income of a dictator during a period of dictatorship ($y \cdot U \cdot t$) is greater or smaller than the income of an educated individual in democracy (g). Another way to express (31) with $\hat{g} = g$ is the following:

²⁷ Appendix 3 details the steps to obtain expression (30).

²⁸ Appendix 3 details the steps to obtain expression (31).

$$(32) \quad t \geq \frac{g}{y.U}$$

The higher the income of an educated individual in democracy compared to that of an educated individual in dictatorship (i.e. the higher g in relation to y), the higher the threshold set by (32), and accordingly, the higher the taxes required for dictatorship to persist. In other words, the greater the income that is 'repressed' by dictatorship (i.e. the higher $\frac{g}{y}$), the more oppressive the dictator will have to be to persist. This means that the dictator will only choose dictatorship if taxes can be high enough; otherwise he will prefer democracy. The lower boundary for t set in (32) only applies if the dictator can make a peaceful transition to democracy and move to the education/production sector and earn an income g .

Now let us assume that the dictator feels that the conditions are not given for him to go through a peaceful transition and enjoy the income of an educated individual in democracy, so he will not give up power voluntarily. In other words, he cannot be accommodated in the democratic regime and gain access to the income g of an educated individual. This can be seen as a return to the initial assumption that in democracy the dictator has no income. In this case, (31) becomes

$$(33) \quad V_{DIC}^d \geq V_{DEM}^d \Rightarrow y.U.t \geq 0$$

and (32) becomes

$$(34) \quad t \geq \frac{0}{y.U} \Rightarrow t \geq 0$$

This means that the dictator will prefer dictatorship as long as the tax rate is not negative. The dictator will always prefer $t \geq 0$ to $t < 0$ because in

the second case his income is negative, whereas in the first case it is not, so the dictator will always prefer dictatorship to democracy.

Note that the minimum threshold set by (34) is lower than the minimum threshold set by (32). In other words, if the dictator can achieve $\hat{g} = g$ in democracy, the range of possible levels of t is more limited than if in democracy he expects $\hat{g} = 0$. If the dictator feels that the conditions are not given for him to go through a peaceful transition and enjoy the income of an educated individual in democracy, he will not give up power and dictatorship may persist for a wider range of values of t . This provides a formal explanation to why some countries have passed ‘amnesty’ legislation to guarantee transitions to democracy: making sure that the dictator can achieve $\hat{g} = g$, the parameter space for dictatorship is reduced and democracy becomes more likely (which is in line with Glaeser, Ponzetto and Shleifer’s 2006 quote in the introduction of this chapter).

Educated Individuals

In a period of dictatorship the net income of an educated individual equals $y \cdot (1-t)$. Following the same procedure as in the previous section, the value function for an educated individual starting in dictatorship becomes:

$$(35) \quad V_{DIC}^e = y \cdot (1-t) + \beta [p \cdot V_{DIC}^e + (1-p) \cdot V_{DEM}^e]$$

from where

$$(36) \quad V_{DIC}^e = \frac{y \cdot (1-t) + \beta(1-p) \cdot V_{DEM}^e}{1 - \beta p}$$

Similarly, the value function for an educated individual starting in democracy is:

$$(37) \quad V_{DEM}^e = g + \beta [p \cdot V_{DIC}^e + (1-p) \cdot V_{DEM}^e]$$

from where

$$(38) \quad V_{DEM}^e = \frac{g + \beta p \cdot V_{DIC}^e}{1 - \beta(1-p)}$$

Inserting (38) in (36), the following value function for an educated individual starting in dictatorship is obtained:

$$(39) \quad V_{DIC}^e = \frac{[y \cdot (1-t)](1 - \beta(1-p)) + [g] \beta(1-p)}{1 - \beta}$$

In the numerator of (39), the net income of an educated individual in dictatorship and in democracy (respectively) appears in square brackets. The income in democracy (g) is weighted by $(\beta(1-p))$ because democracy can happen in next period (thus the discount factor β) with probability $(1-p)$. The complement of that weight is $(1 - \beta(1-p))$, which is exactly the weight given in the numerator to the income in dictatorship $[y \cdot (1-t)]$. Inserting (39) back in (38), the value for an educated individual starting in democracy is:

$$(40) \quad V_{DEM}^e = \frac{[g] \cdot (1 - \beta p) + [y \cdot (1-t)] \beta p}{1 - \beta}$$

Expression (40) has a similar interpretation to (39): the numerator shows the income in dictatorship weighted by its probability (p) discounted by β (because dictatorship can happen in next period, so the income for dictatorship is multiplied by βp), plus the income in case of democracy weighted by the complement of the weight of dictatorship $(1 - \beta p)$.

From (39) and (40) I determine when the educated individuals will prefer dictatorship to democracy and vice versa. As long as $V_{DIC}^e \geq V_{DEM}^e$, the

educated individuals will prefer dictatorship to democracy²⁹. From (39) and (40),

$$(41) \quad V_{DIC}^e \geq V_{DEM}^e \Rightarrow y \cdot (1-t) \geq g$$

As $g > y$, then (41) is false. This means that educated individuals will never prefer dictatorship to democracy. They will only be indifferent between both regimes when $t=0$ and $g = y$ (in which case education expenditure does not affect income, which is not what I assume here).

Transfers

From the rejection of (41) above, for educated individuals $V_{DEM}^e > V_{DIC}^e$. In consequence, educated individuals have an incentive to offer a transfer to the uneducated individuals if they stay out of the army. As before, if $(N - U - \bar{n} + \varepsilon)$ non-educated individuals are persuaded not to join the army, the minimum threshold \bar{n} will not be reached and dictatorship collapses. That will require the level of transfers per non-educated individual given by (3). In consequence,

$$(42) \quad V_{DEM}^e = \left[g - \frac{T \cdot (N - U - \bar{n} + \varepsilon)}{U} \right] + \beta \left[p V_{DIC}^e + (1-p) V_{DEM}^e \right]$$

$$(43) \quad V_{DIC}^e = y(1-t) + \beta \left[p V_{DIC}^e + (1-p) V_{DEM}^e \right]$$

With the transfers, the educated individuals will be indifferent between democracy and dictatorship if (42)=(43) (in which case I assume dictatorship

²⁹ Where I am assuming that if indifferent, they choose dictatorship

persists), and they will prefer to make transfers to reach democracy if (42)>(43), which can be expressed as

$$(44) \quad \left[g - \frac{T.(N-U-\bar{n}+\varepsilon)}{U} \right] > y.(1-t)$$

Operating, (44) implies

$$(45) \quad t > 1 - \frac{1}{y} \cdot \left[g - \frac{T.(N-U-\bar{n}+\varepsilon)}{U} \right]$$

which the same result obtained in (8) for the static case.

If the tax rate satisfies (45), then transfers will take place and democracy will override dictatorship. As in expression (8), in expression (45) the parameter space for dictatorship decreases as $\frac{g}{y}$ increases (a greater ratio

$\frac{g}{y}$ means that the highest possible tax rate in dictatorship decreases).

For a given amount of education expenditure (that is, for a given $[1-w.n]$), the ratio $\frac{g}{y}$ measures the impact on the level of income of spending an additional amount of $w.n$ on education, that is, the increase in income that can be induced through an increase of $w.n$ monetary units in education expenditure (because $g=y(1)$). According to (32), (41) and (45), dictatorships benefit from a lower $\frac{g}{y}$, and indeed, dictatorships have to give way to democracies if $\frac{g}{y}$ is too high according to those expressions. Put in other words, for a given amount of education expenditure, dictatorships (compared to democracies) need to show a lower impact of education on income to survive.

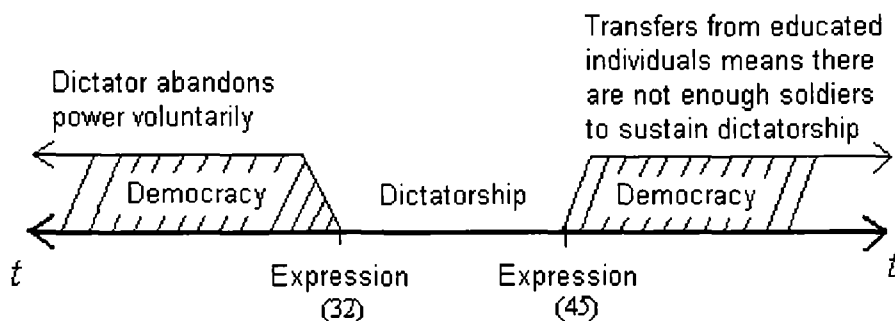
The assumption that the dictator can earn g in democracy means that the tax rate consistent with dictatorships has upper and lower constraints:

while (45) provides the upper constraint, expression (32) shows the lower constraint. Putting both expressions together, dictatorship will be possible if

$$(46) \quad \frac{g}{y.U} \leq t \leq 1 - \frac{1}{y} \cdot \left[g - \frac{T \cdot (N - U - \bar{n} + \varepsilon)}{U} \right]$$

Expression (46) is represented graphically in figure 2.

Figure 2



If the income of an educated individual in democracy is much higher than that of an educated individual in dictatorship (so $\frac{g}{y}$ becomes higher, which means that there is a greater effect of education expenditure on income), there is room for the educated individuals in democracy to transfer money to the soldiers, so dictatorship ends. At the same time, if $\frac{g}{y}$ is too high, the dictator may find he is better off abandoning his position and favouring a transition to democracy, in which case he can become an educated individual.

From expression (46), there are at least three requirements for dictatorship to exist:

-First, the right hand side of (32) cannot be greater than the right hand side of (45). This can be expressed as

$$(47) \quad \frac{g}{y.U} \leq 1 - \frac{1}{y} \cdot \left[g - \frac{T.(N-U-\bar{n}+\varepsilon)}{U} \right]$$

which can be re-expressed as

$$(47') \quad \frac{g}{y} \leq \frac{U}{1+U} \cdot \left[1 + \frac{T.(N-U-\bar{n}+\varepsilon)}{y} \right]$$

Again, (47') shows that the greater the impact of education expenditure on income (the greater $\frac{g}{y}$), the smaller the tax space of dictatorship.

-Second, the right hand side of (45) has to be positive (otherwise dictatorship requires a negative tax rate). Again, this also depends on the size of the impact of education expenditure on income: if $\frac{g}{y}$ is too big, the dictator cannot set positive taxes (according to (32)), so dictatorship gives place to democracy.

-Third, the right hand side of (32) has to be at most equal to 1 (otherwise dictatorship requires a tax rate greater than 1). This can be expressed as

$$(48) \quad \frac{g}{y.U} \leq 1$$

Therefore, (47') and (48) give the conditions under which the dictator will be able to set a positive tax rate that will avoid democracy. These two conditions make it clear that dictatorships require a low level of $\frac{g}{y}$. In other words, dictatorships require that the level of income achievable in democracy by an educated individual is not much higher than the level of income achievable in dictatorship by an educated individual. A low $\frac{g}{y}$ means that the

additional resources that would go to education in the case of a transition from dictatorship to democracy ($w.n$) will have a low impact on income.

A variation: transfers in corruption

Suppose that while in the army, soldiers benefit from the proximity to the ruling power and from being insiders in the military body that exercises government. These benefits are not legal, but obtained through bribes and other forms of corruption. I summarise all these benefits that a soldier i could get, in the parameter δ_i .

I assume that the parameter δ_i is distributed uniformly between 0 (no benefit) and a maximum benefit $\bar{\delta}$ across all the non-educated individuals. The dictator does not know the value of δ_i of each uneducated individual, but he knows its distribution. Temporarily, I will refer to the wage that the dictator pays as w^c . Therefore,

$$(49) \quad V_{DIC}^{s,i} = (w^c + \delta_i) + \beta \left[pV_{DIC}^{s,i} + (1-p)V_{DEM}^{s,i} \right]$$

and

$$(50) \quad V_{DEM}^{s,i} = w^* + \beta \left[pV_{DIC}^{s,i} + (1-p)V_{DEM}^{s,i} \right]$$

where I added the upperscript i to the value functions to represent the fact that each soldier ends up receiving a different income according to the extra benefits perceived. Now, the dictator can internalise some part of the bribing benefits into the soldiers' wage, so that $w^c + \delta_i \geq w^*$ (note that no soldier

will want to stay in the army if $w^C + \delta_i < w^*$).³⁰ In particular, the dictator can keep on paying the market wage w^* and let the soldiers fully benefit from the bribes (in which case $w^C = w^*$ and $V_{DIC}^{s,i} = (w^* + \delta_i) + \beta [pV_{DIC}^{s,i} + (1-p)V_{DEM}^{s,i}]$).

If the dictator internalises part of the benefit δ_i in the wage he pays and offers a wage $w = w^C$ lower than the market wage w^* , the soldiers will receive the payment w^C from the dictator and the bribes δ_i from their bribers.

Soldiers will only accept to work for the dictator if

$$(51) \quad V_{DIC}^{s,i} \geq V_{DEM}^{s,i} \quad 31$$

which can also be expressed as

$$(52) \quad V_{DIC}^{s,i} = (w^C + \delta_i) + \beta [pV_{DIC}^{s,i} + (1-p)V_{DEM}^{s,i}] \geq \\ \geq V_{DEM}^{s,i} = w^* + \beta [pV_{DIC}^{s,i} + (1-p)V_{DEM}^{s,i}]$$

To minimise the payments he makes, the dictator will try to recruit the uneducated individuals with the highest levels of δ_i . For example, if the dictator tries to recruit the lowest possible number of soldiers (\bar{n}), then he will need to identify the level of $\delta_i = \hat{\delta}$ such that \bar{n} uneducated individuals have $\delta_i \geq \hat{\delta}$. This will allow him to minimise the payments w^C and let the bribing benefits contribute to attract uneducated individuals towards the army. Given that δ_i is uniformly distributed

³⁰ As the dictator does not know the δ_i of each uneducated individual, the dictator will offer the same wage w^C to all of them.

³¹ Again, I am assuming that if both values are equal, the soldiers prefer dictatorship.

between 0 and $\bar{\delta}$ across all non-educated individuals, and considering that the total number of non-educated individuals is $(N-U)$, then

$$(53) \quad \hat{\delta} = \left[\frac{N-U-\bar{n}}{N-U} \right] \cdot \bar{\delta}$$

so the wage w^C will be such that

$$(54) \quad (w^* - \hat{\delta}) \leq w^C \leq w^*$$

With $(w^* - \hat{\delta}) \leq w^C$, expression (54) means that the wage paid by the dictator (w^C) has to be such that $w^C + \hat{\delta} \geq w^*$. This will attract the \bar{n} individuals for which $\delta_i \geq \hat{\delta}$, because the total payments they will receive (w^C from the dictator and $\delta_i \geq \hat{\delta}$ from their bribers) will be equal or higher than the wage they can obtain working in the informal sector. This means that $\hat{\delta}$ is the maximum level of bribing benefits that the dictator can internalise in the soldiers' wages.

With $w^C \leq w^*$, expression (54) says that the internalisation can at least be zero, and the dictator can pay the market wage on top of the bribing benefits received by the soldiers.

Originally I assumed that the dictator has a chance to stay in power only if $w^* \cdot \bar{n} \leq 1$. Now, as he is only paying w^C , that constraint becomes $w^C \cdot \bar{n} \leq 1$. This means that the level of transfers that leaves the dictator with no chance of hiring soldiers (from the dictator side) becomes

$$(55) \quad T^C = \frac{1}{\bar{n}} - w^C + \alpha$$

where $\alpha \rightarrow 0^+$. Expression (55) is similar to (3), with the difference that now w^C replaces w^* . According to (54), $w^C \leq w^*$, so in consequence $T^C \geq T$, which means that the level of transfers that leaves the dictator without chance of hiring soldiers has

increased or stayed the same. If it increased, it is now more expensive for the educated individuals to ‘outbudget’ the dictator.

In particular, according to (54), $(w^* - \hat{\delta}) \leq w^C$. Therefore, substituting (53) in (54), the smallest possible level of w^C is

$$(56) \quad w^C = w^* - \left[\frac{N - U - \bar{n}}{N - U} \right] \bar{\delta}$$

which means that (inserting (56) in (55)), the highest possible level of T^C is

$$(57) \quad T^C = \frac{1}{\bar{n}} - \left\{ w^* - \left[\frac{N - U - \bar{n}}{N - U} \right] \bar{\delta} \right\} + \alpha = \frac{1}{\bar{n}} - w^* + \left[\frac{N - U - \bar{n}}{N - U} \right] \bar{\delta} + \alpha$$

However, this may still not be enough to end dictatorship, because (57) only accounts for the dictator side. Now ‘outbudgeting’ the dictator may not be enough: avoiding dictatorship requires that the uneducated individuals receive transfers that compensate for the bribes too. If the dictator offers a wage w^C , then the potential benefits that each uneducated individual perceives from joining the army are distributed uniformly between $[w^C; w^C + \bar{\delta}]$.³² So the potential benefits that each uneducated individual perceives from joining the army *over and above* working in the informal sector at a wage rate w^* , are distributed uniformly between $[w^C - w^*; w^C + \bar{\delta} - w^*]$.

In consequence, if educated individuals were to pay a transfer F to persuade $(N - U - \bar{n} + \varepsilon)$ non-educated individuals not to join the army (which is a condition to avoid dictatorship), then their transfer has to compensate for the extra income that

³² Because the bribes are distributed uniformly between $[0; \bar{\delta}]$ and the wage paid by the dictator is w^C .

the uneducated individuals perceive from joining the army *over and above* working in the informal sector at the wage rate w^* .

$$(58) \quad F = \left[\frac{N-U-\bar{n}+\varepsilon}{N-U} \right] \cdot [w^c + \bar{\delta} - w^* - (w^c - w^*)]$$

The first square bracket of (58) derives from the fact that there are $(N-U)$ uneducated individuals, of which $(N-U-\bar{n}+\varepsilon)$ have to be persuaded not to join the army. The second square bracket of (58) shows the difference between the maximum possible payment $(w^c + \bar{\delta} - w^*)$ and the minimum possible payment $(w^c - w^*)$ that a soldier can receive in the army (including bribes) over and above the market wage rate (this has been derived above). Uneducated individuals are distributed uniformly along that difference. Therefore, the multiplication of both square brackets in (58) shows the level of transfers F that will be required to persuade $(N-U-\bar{n}+\varepsilon)$ uneducated individuals not to join the army and secure a higher level of net income through transfers in democracy.

Expression (58) can be re-expressed as

$$(58') \quad F = \left[\frac{N-U-\bar{n}+\varepsilon}{N-U} \right] \cdot \bar{\delta}$$

Now, the transfer that the educated individuals have to offer to avoid dictatorship is given by $Max (F; T^c)$. We do not know a priori whether $T^c \succ F$, because

$$(59) \quad T^c \succ F \Rightarrow \frac{1}{\bar{n}} - w^* + \left[\frac{N-U-\bar{n}}{N-U} \right] \cdot \bar{\delta} + \alpha \succ \left[\frac{N-U-\bar{n}+\varepsilon}{N-U} \right] \cdot \bar{\delta} \Rightarrow$$

$$\Rightarrow (\text{assuming } \varepsilon = \alpha = 0) \quad \Rightarrow \frac{1}{\bar{n}} - w^* \succ 0 \Rightarrow 1 \succ w^* \cdot \bar{n}$$

Now that the dictator pays $w = w^c$ we know that dictatorship requires $w^c \cdot \bar{n} \leq 1$, but we do not know whether $w^* \cdot \bar{n} > 1$.

Educated individuals will be willing to pay this transfer only if $V_{DEM}^e > V_{DIC}^e$ (assuming that if $V_{DEM}^e = V_{DIC}^e$, the educated individuals prefer dictatorship), where now V_{DEM}^e is given by

$$(60) \quad V_{DEM}^e = \left[g - \frac{Max(F; T^c) \cdot (N - U - \bar{n} + \varepsilon)}{U} \right] + \beta \left[p \cdot V_{DIC}^e + (1 - p) \cdot V_{DEM}^e \right]$$

and V_{DIC}^e is still given by (43), reproduced here

$$(43) \quad V_{DIC}^e = y(1 - t) + \beta \left[p V_{DIC}^e + (1 - p) V_{DEM}^e \right]$$

According to (60) and (43), the condition $V_{DEM}^e > V_{DIC}^e$ translates into

$$(61) \quad \left[g - \frac{Max(F, T^c) \cdot (N - U - \bar{n} + \varepsilon)}{U} \right] > y \cdot (1 - t)$$

From where

$$(62) \quad t > 1 - \frac{1}{y} \cdot \left[g - \frac{Max(F, T^c) \cdot (N - U - \bar{n} + \varepsilon)}{U} \right]$$

This is very similar to (45), with the difference that in (62), $Max(F, T^c)$ replaces T . As I showed that $T^c \geq T$, then the threshold level of taxes obtained in (62) is greater than the threshold obtained in (45). Expressions (57) and (58) show that the more corrupt the system is (the higher are the bribes obtainable, so the higher is $\bar{\delta}$), the higher will be T^c and F respectively. In expression (62), this means that if all other factors are constant, more corruption (higher $\bar{\delta}$) translates to a higher tax rate reachable by the dictator without giving way to democracy. In consequence, dictators

will benefit from giving concessions and power of influence to the soldiers. This is consistent with the assertion in chapter 1 that dictatorships are more corrupt than democracies.

Conclusions

In this chapter I approached the issue of the sustainability of dictatorships and democracies from the perspective of the effects of education expenditure on income, given a finite labour market.

Previous researchers have referred to the educational trade-off faced by dictators, in the sense that more education means more income and thus more revenue, but at the same time this poses a risk for the dictator (Bourguignon and Verdier (2000), Glaeser, Ponzetto and Shleifer (2006), Acemoglu (2003), Acemoglu and Robinson (2000, 2002 and 2006) and Robinson (1999); see discussion in the literature review of the first chapter). However, this is the first time that the returns to expenditure in education (in terms of increased personal income) are included in the analysis, which is the main innovation of this chapter.

I do not claim that the returns to expenditure in education determine the existence of dictatorships or democracies. However, I have shown that this factor puts some restrictions on the power of the dictators, influencing the transitions to democracy and dictatorship. Having the political power does not mean that the dictator has no restrictions; he needs people to support him and protect him, and he also needs people to work in the productive sector in order to have a source of tax revenue. As he needs others, this gives power to those 'others', thus the transfers offered by educated individuals are a threat to the stability of the dictatorship. The analysis of transitions between democracy and dictatorship has never before been approached through looking simultaneously at the effects of education expenditure on income and the

pressures from a limited labour market on the extractive powers of the dictators. This is the single most important contribution of this chapter.

For this model I have used the military versus education/production because it gives a clear image of the kind of trade-offs faced by dictators. However, this model can be extended to cover more general considerations: the dictator needs not only the military, but also bureaucracy to run the state apparatus. Likewise, the model can incorporate minimum technological thresholds of employment in the bureaucratic apparatus, representing the fact that the state cannot be run with less than a certain number of employees (a concept similar to \bar{n} in this chapter). This presents the same kind of trade-offs as those analysed in this model with the military, but expanded to all the staff that the dictator needs to hire.

The model presented in this chapter explains why redistributive policies should be more extended in democracies than in non-democracies (which has been argued by previous researchers), and why some countries need to resort to amnesties to facilitate peaceful transitions to democracy.

Another key implication is related to why dictators should be expected to 'blur' the effect of education on income, an implication that is empirically tested in the next chapter. According to Pritchett's (2001) 'piracy' argument, in some countries the institutional environment is 'sufficiently perverse' so that education does not lead to macroeconomic growth. In the terms of the model of this chapter, Pritchett's hypothesis means that in those 'perverted' environments, the ratio $\frac{g}{y}$ has to be relatively low (if education does not lead to growth, then $g=y$). In this case, according to (45) and (32), dictatorship is more likely to ensue. The 'perversion' of the education-growth link can come from different sources (more on this in the next chapter) but one of the sources can be related to the parameter $\bar{\delta}$ used here: if the dictator corrupts the system so that certain sectors get special favours, influence and power (I have shown

above that the dictator is interested in increasing $\bar{\delta}$) regardless of their education, then the relative benefit of education perceived by society decreases. This gives way to at least two possible outcomes.

The first possible outcome is that of countries with a 'perverse' institutional environment, with low impact of education on growth, and which are non-democratic. A second possible outcome arises for countries without 'perverse' institutional environments, where in consequence education expenditure has a greater impact on growth. This increases the ratio $\frac{g}{y}$, making democracy more likely. In consequence, this second outcome includes countries with non-'perverted' institutional environments, with higher impact of education on growth, and with democratic governments.

There are reasons to believe a priori that each of those outcomes should have some degree of stability. For instance, let me assume that a dictatorial country has a non-'perverted' institutional environment, in Pritchett's (2001) sense. In this case, a greater impact of education on income means that a relatively higher $\frac{g}{y}$ should be expected, which facilitates a transition to democracy. The final outcome is a democratic country with a high $\frac{g}{y}$ and a non-'perverted' institutional environment. In the same way, in a democratic country with a 'perverted' institutional environment such that education has a lower impact on income, $\frac{g}{y}$ will be relatively lower, which facilitates a transition to non-democracy. As a result, the final outcome is that of a non-democratic country with a low $\frac{g}{y}$ and a 'perverted' institutional environment.

According to this, non-democracies could be summarising the 'black box' to which Pritchett refers with the 'institutional/governance environments'

that are 'sufficiently perverse' to prevent education from having a positive impact on economic growth. This closes the circle and reinforces the idea of two stable equilibria: for the first outcome, non-democracies have 'perverse' institutions that lead to lower impacts of education on growth (lower $\frac{g}{y}$), which in turn facilitates non-democracy. For the second outcome, democracies have 'non-perverse' institutions that lead to greater impacts of education on growth (higher $\frac{g}{y}$), which in turn facilitates democracy. However, for this to be operating, it remains to be tested whether democracy gives place to greater impacts of education on growth than non-democracy. This will be tested in the next chapter.

As discussed in the literature review of chapter 1, scholars have agreed that richer countries tend to be more democratic than poorer countries (Lipset 1960, Acemoglu and Robinson 2006, Acemoglu, Johnson, Robinson and Yared 2004, Dahl 1971 among many others), though establishing causalities does not generate a similar consensus. If richer countries tend to be more democratic, then the characteristics of the two previous equilibria could be extended and described as follows:

a) If richer countries are more democratic than the poorer countries (as demonstrated by previous scholars), they will also tend to show higher macroeconomic returns to education expenditure (as shown in this chapter, $\frac{g}{y}$ should be greater in democracies than in non-democracies). This group is then characterised by countries that are richer, show higher macroeconomic returns to education, and are more democratic.

b) If poorer countries are less democratic than the rich countries (as demonstrated by previous scholars), they will also tend to show lower macroeconomic returns to education (as shown in this chapter, $\frac{g}{y}$ should be

smaller in non-democracies than in democracies). This group is then characterised by countries that are poorer, show lower macroeconomic returns to education, and are less democratic.

More research into the stability of these two equilibria is needed, although at this stage and for the reasons detailed above, the findings obtained in the last chapters suggest that these two equilibria are stable and that some degree of institutional persistence should be expected.

Appendix 1: The distributional effects of transfers in the static model

This model does not present a general conclusion on whether the transition from dictatorship to democracy results in a more equal or unequal distribution of income.

Intuitively, the argument is as follows: in dictatorship, the dictator can extract a proportion of taxes such that the income of the educated individuals is very low and very close to that of the non-educated individuals. This would create a virtually equal distribution of income. However, in democracy the educated individuals can make transfers to a great proportion of non-educated individuals (to avoid dictatorship), such that the income of the non-educated increases, reducing the gap between the income of the educated and the non-educated.

In dictatorship, educated individuals earn a net income of $y \cdot (1-t)$ and non-educated individuals earn w^* . If democracy is achieved through transfers from the educated to the non-educated individuals, then there are three levels of income: (i) educated individuals earn a net income of $g - \frac{T \cdot (N - U - \bar{n} + \varepsilon)}{U}$; (ii) the $(N - U - \bar{n} + \varepsilon)$ non-educated individuals that receive transfers earn a net income $(w^* + T)$; (iii) the $(U + \bar{n} - \varepsilon)$ non-educated individuals that do not receive transfers earn a net income of w^* .

Figure (a1.1) provides a representation of the change in the dispersion of income.

Figure a1.1

	Dictatorship		Democracy
Educated	$y \cdot (1-t)$	$<$	$g - \frac{T^* \cdot (N - U - \bar{n} + \varepsilon)}{U}$
Non-educated	w^*	\swarrow $<$ \searrow	$w^* + T^* \quad (N - U - \bar{n} + \varepsilon)$ individuals $= w^* \quad (U + \bar{n} - \varepsilon)$ individuals

Figure (a1.1) shows that for the educated and non-educated individuals, a transition from dictatorship to democracy represents a Pareto improvement from the point of view of income: nobody is worse off, while the educated individuals (and some non-educated) are better off.

However, the effect on the distribution of income is ambiguous for the following reasons:

First, the range of income disparities increases: whereas $(U + \bar{n} - \varepsilon)$ non-educated individuals do not receive transfers in democracies and their income remains constant in both regimes, all the educated individuals see their income increase in democracy when compared to dictatorship. This means that the distance between the incomes of the educated and the non-educated that do not receive transfers ($(U + \bar{n} - \varepsilon)$ of non-educated individuals) increases, which translates into a more unequal distribution of income.

Second, there is the disparity of income between the educated individuals and the $(N - U - \bar{n} + \varepsilon)$ non-educated individuals who receive transfers. To assess whether the income gap between these two groups increases or decreases with the transition from dictatorship to democracy, I check

$$(a1.1) \frac{g - \frac{T.(N-U-\bar{n}+\epsilon)}{U}}{w^*+T} \gg \frac{y.(1-t)}{w^*}$$

The left hand side of expression (a1.1) shows the ratio of incomes between these two groups in democracy, and the right hand side shows the ratio of incomes between these two groups in dictatorship. Operating, expression (a1.1) implies

$$(a1.2) t \gg 1 - \left[\frac{w^*}{w^*+T} \right] \cdot \left[\frac{g}{y} - \frac{T.(N-U-\bar{n}+\epsilon)}{U.y} \right]$$

This means that the income gap between these two groups will increase in democracy relative to dictatorship if

$t > 1 - \left[\frac{w^*}{w^*+T} \right] \cdot \left[\frac{g}{y} - \frac{T.(N-U-\bar{n}+\epsilon)}{U.y} \right]$ and will decrease if

$t < 1 - \left[\frac{w^*}{w^*+T} \right] \cdot \left[\frac{g}{y} - \frac{T.(N-U-\bar{n}+\epsilon)}{U.y} \right]$. This looks similar to the limits set

by expression (10). However, given that $\left[\frac{w^*}{w^*+T} \right] < 1$, the right hand side of

(a1.2) is greater than the right hand side of (10). For this reason, expression

(a1.2) can be incorporated into figure 1 in the way shown in figure (a1.2).

Figure a1.2

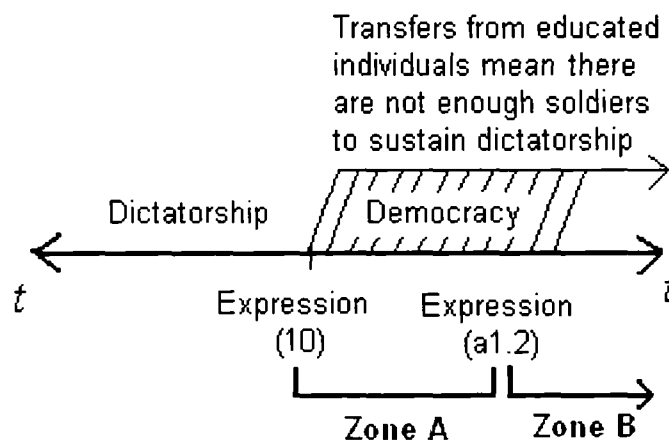


Figure (a1.2) reproduces figure 1 but adds 2 zones (A and B) derived from expression (a1.2). When democracy arises through transfers, the relevant area is that to the right of expression (10) in figure (a1.2). Whether income distribution between the educated individuals and the non-educated ($N-U-\bar{n}+\varepsilon$) individuals that receive transfers gets more or less equal, depends on the original level of taxes in dictatorship: if taxes are in Zone B (so expression (a1.2) becomes $t > 1 - \left[\frac{w^*}{w^*+T} \right] \cdot \left[\frac{g}{y} - \frac{T \cdot (N-U-\bar{n}+\varepsilon)}{U \cdot y} \right]$), then the ratio of incomes between these two groups will increase, making income distribution more unequal. If taxes are in Zone A (so expression (a1.2) becomes $t < 1 - \left[\frac{w^*}{w^*+T} \right] \cdot \left[\frac{g}{y} - \frac{T \cdot (N-U-\bar{n}+\varepsilon)}{U \cdot y} \right]$), then the ratio of incomes between these two groups will decrease, making income distribution more equal.

The impact of this second factor in the income distribution of each regime is ambiguous: it depends on the level of taxes in dictatorship, but also on the relative size of the non-educated population that receives transfers. If the proportion of the population that falls in this category is small, then the impact of this factor on total income distribution will be small.

Third, there is another factor not reflected in (a1.1) that has an impact on the distribution of income: in dictatorship, one individual (the dictator himself) receives a (presumably relatively) large income, whereas in democracy that same person will be earning either the same income as the educated individuals or no income at all (this depends on the assumptions made). This could also affect the distribution of income in one direction or the other. The effect of this will depend (among other factors) on the size of the total population.

The three arguments presented above show that there are contradictory effects on income distribution derived from regime changes, though the model presented in this chapter showed that democracies can be expected to have more redistributive policies in place transferring income from the educated to the non-educated (loosely, from the rich to the poor).

Appendix 2: An example of the static model with linear y

This appendix presents an example of the static version of the model, using a linear function $y(1-wn)=1-wn$. In this case, $y'=1$ and $g=y(1)=1$. From (14) it follows that

$$\begin{aligned}
 \text{(a2.1)} \quad n &= \frac{y-z}{w \cdot y'} = \frac{1-wn-z}{w \cdot 1} \Rightarrow wn = 1 - wn - z \Rightarrow 2wn = 1 - z \Rightarrow n = \frac{1-z}{2w} \\
 \text{(a2.2)} \quad z &= g - \frac{T \cdot (N - U - \bar{n} + \varepsilon)}{U} = 1 - \frac{T \cdot (N - U - \bar{n} + \varepsilon)}{U} \\
 \text{(a2.3)} \quad n &= \frac{T \cdot (N - U - \bar{n} + \varepsilon)}{2wU}
 \end{aligned}
 \left. \vphantom{\begin{aligned} \text{(a2.1)} \\ \text{(a2.2)} \\ \text{(a2.3)} \end{aligned}} \right\} \Rightarrow$$

Inserting the expression for T as in (3):

$$\text{(a2.4)} \quad n = \frac{\left(\frac{1}{\bar{n}} - w + \alpha \right) \cdot (N - U - \bar{n} + \varepsilon)}{2wU}$$

Considering that $w=w^*$ is given exogenously for the dictator, then

$$\text{(a2.5)} \quad n = \frac{\left(\frac{1}{\bar{n}} - w^* + \alpha \right) \cdot (N - U - \bar{n} + \varepsilon)}{2w^*U}$$

which can be re-expressed as

$$(a2.6) \quad n = \left[\frac{1}{w^*} \cdot \left(\frac{1}{\bar{n}} + \alpha \right) - 1 \right] \cdot \frac{(N - U - \bar{n} + \varepsilon)}{2U}$$

Expression (a2.6) represents the demand curve for soldiers. It is straightforward to see that the relationship between n and w^* is negative, as would be expected from a demand curve. For dictatorship (and demand for soldiers) to exist, $w^* \bar{n} \leq 1$, so $\frac{1}{w^* \bar{n}} \geq 1$, which means that $n > 0$.

According to (10), the maximum level of taxes that the dictator can set is

$$(a2.7) \quad t = 1 - \frac{1 - \left(\frac{1}{\bar{n}} - w^* + \alpha \right) \cdot (N - U - \bar{n} + \varepsilon)}{1 - w^* n}$$

which can be re-expressed as

$$(a2.8) \quad t = \frac{\left(\frac{1}{\bar{n}} - w^* + \alpha \right) \cdot \left(\frac{N - U - \bar{n} + \varepsilon}{U} \right) - w^* n}{1 - w^* n}$$

Inserting the value of n from (a2.5) and operating, this becomes

$$(a2.9) \quad t = \frac{\left(\frac{1}{\bar{n}} - w^* + \alpha \right) \cdot (N - U - \bar{n} + \varepsilon)}{2U - \left(\frac{1}{\bar{n}} - w^* + \alpha \right) \cdot (N - U - \bar{n} + \varepsilon)}$$

To interpret expression (a2.9) it is worth simplifying it using T rather than $\left(\frac{1}{\bar{n}} - w^* + \alpha \right)$. Therefore, (a2.9) becomes

$$(a2.10) \quad t = \frac{T \cdot (N - U - \bar{n} + \varepsilon)}{2U - T \cdot (N - U - \bar{n} + \varepsilon)}$$

Expression (a2.10) defines the maximum level of dictatorial taxes as a function of exogenous variables. Expression (a2.10) implies that:

- (i) For other factors constant, when a higher level of transfers are required to stop dictatorship (when T is greater), the dictator can set a higher tax rate. This is an expected result: more expensive democracies (that is, the higher the transfers necessary to obtain democracy) mean that the dictator can set a higher price for dictatorship (higher tax rates) without risking being overthrown.
- (ii) For other factors constant, a larger educated population (greater U) means that the tax rate will be lower. This was also expected: when the educated population is greater, it is cheaper for each educated individual to pay the required transfers to obtain democracy, so the dictator needs to lower the tax rate to avoid democracy.
- (iii) For other factors constant, a greater minimal size of the army (a greater \bar{n}) means a lower maximum tax rate. This was also expected: when the minimum number of soldiers that the dictator has to recruit increases, dictatorship becomes more expensive for him and democracy becomes cheaper for the educated individuals (because the number of people they need to keep out of the army to make dictatorship collapse decreases).

Finally, the choice of $y=(1-wn)$ implies the relationship $\frac{g}{y} = \frac{1}{1-wn}$,

which is particularly relevant for the implications derived from this chapter.

With $w=w^*$, any increase in n will increase $\frac{g}{y} = \frac{1}{1-wn}$; in other words, for a

fixed level of wages, the greater the size of the army, the more the income of an educated individual in dictatorship is repressed (and so the more the

educated individuals will be willing to pay the necessary transfers to obtain democracy, which is why the maximum possible level of dictatorial taxes is negatively related to $\frac{g}{y}$). From expression (a2.5), n is negatively related to U and \bar{n} , and positively related with T , so increases in T increase $\frac{g}{y}$, whereas increases in U or \bar{n} decrease $\frac{g}{y}$.

An increase in w^* has two opposing effects on w^*n : first, there is the positive direct effect of a greater w^* on w^*n , but also greater w^* decreases n . So the total effect of an increase in w^* on w^*n can be seen in (a2.11) (obtained from multiplying expression (a2.5) by w^*):

$$(a2.11) \quad w^*n = \frac{\left(\frac{1}{\bar{n}} - w^* + \alpha\right) \cdot (N - U - \bar{n} + \varepsilon)}{2U}$$

From expression (a2.11), an increase in w^* translates into a decrease in w^*n . This means that an increase in w^* translates into an increase in $(1-w^*n)$, from where an increase in w^* translates into a decrease in $\frac{g}{y} = \frac{1}{1-w^*n}$. Summarising, the greater the market level of wages, the less income is repressed by the dictatorship (which in turn means that educated individuals will be less likely to pay the transfers necessary to obtain democracy).

Appendix 3: Detailed steps of some operations

Detailed steps to get expression (30)

I obtained expression (30) after inserting (29) into (28), where

$$(28) \quad V_{DEM}^d = \frac{\hat{g} + \beta p \cdot V_{DIC}^d}{1 - \beta(1 - p)}$$

$$(29) \quad V_{DIC}^d = \frac{y \cdot U_t \cdot [1 - \beta(1 - p)] + \hat{g} \cdot \beta \cdot (1 - p)}{1 - \beta}$$

After inserting (29) into (28), I obtain

$$(a3.1) \quad V_{DEM}^d = \frac{\hat{g}}{1 - \beta(1 - p)} + \frac{\beta p}{1 - \beta(1 - p)} \cdot \frac{y \cdot U_t \cdot [1 - \beta(1 - p)] + \hat{g} \cdot \beta \cdot (1 - p)}{1 - \beta}$$

$$(a3.2) \quad V_{DEM}^d = \frac{\hat{g}}{1 - \beta(1 - p)} + \frac{\beta p y U_t}{1 - \beta} + \frac{\beta p \hat{g} \beta (1 - p)}{(1 - \beta)(1 - \beta(1 - p))}$$

$$(a3.3) \quad V_{DEM}^d = \frac{\hat{g}}{1 - \beta(1 - p)} \cdot \left[1 + \frac{\beta^2 p (1 - p)}{1 - \beta} \right] + \frac{\beta p y U_t}{1 - \beta}$$

$$(a3.4) \quad V_{DEM}^d = \frac{\hat{g}}{1 - \beta(1 - p)} \cdot \left[1 + \frac{\beta^2 p (1 - p)}{1 - \beta} \right] + \frac{\beta p y U_t}{1 - \beta}$$

$$(a3.5) \quad V_{DEM}^d = \frac{\hat{g}}{1 - \beta(1 - p)} \cdot \left[\frac{1 - \beta + \beta^2 p (1 - p)}{1 - \beta} \right] + \frac{\beta p y U_t}{1 - \beta}$$

$$(a3.6) \quad V_{DEM}^d = \frac{\hat{g}}{1 - \beta} \cdot \left[\frac{1 - \beta + \beta^2 p (1 - p)}{1 - \beta(1 - p)} \right] + \frac{\beta p y U_t}{1 - \beta}$$

But $(1 - \beta p) = \left[\frac{1 - \beta + \beta^2 p(1 - p)}{1 - \beta(1 - p)} \right]$, so (a3.6) becomes

$$(a3.7) \quad V_{DEM}^d = \frac{\hat{g}}{1 - \beta} \cdot (1 - \beta p) + \frac{\beta pyUt}{1 - \beta}$$

$$(a3.8) \quad V_{DEM}^d = \frac{\hat{g}}{1 - \beta} - \frac{\hat{g}\beta p}{1 - \beta} + \frac{\beta pyUt}{1 - \beta}$$

But $\frac{\hat{g}}{1 - \beta} = \hat{g} + \frac{\hat{g}\beta}{1 - \beta}$, so (a3.8) becomes

$$(a3.9) \quad V_{DEM}^d = \hat{g} + \frac{\hat{g}\beta}{1 - \beta} - \frac{\hat{g}\beta p}{1 - \beta} + \frac{\beta pyUt}{1 - \beta}$$

from where

$$(a3.10) \quad V_{DEM}^d = \hat{g} + \beta \left[\frac{\hat{g}(1 - p) + pyUt}{1 - \beta} \right], \text{ which equals (30).}$$

Detailed steps to get expression (31)

I obtained expression (31) after comparing (30) and (29).

$$(29) \quad V_{DIC}^d = \frac{y.U.t.[1 - \beta(1 - p)] + \hat{g}.\beta.(1 - p)}{1 - \beta}$$

$$(30) \quad V_{DEM}^d = \hat{g} + \beta \left[\frac{\hat{g}(1 - p) + pyUt}{1 - \beta} \right]$$

$$(31) \quad y.U.t \geq \hat{g}$$

For simplicity, instead of using expression (30), to represent V_{DEM}^d I use the equivalent following expression (derived above):

$$(a3.7) \quad V_{DEM}^d = \frac{\hat{g}}{1-\beta} \cdot (1-\beta p) + \frac{\beta pyUt}{1-\beta}$$

Starting from $V_{DIC}^d \geq V_{DEM}^d$,

$$(a3.11) \quad \frac{y.U.t.[1-\beta(1-p)] + \hat{g} \cdot \beta \cdot (1-p)}{1-\beta} \geq \frac{\hat{g}}{1-\beta} \cdot (1-\beta p) + \frac{\beta pyUt}{1-\beta}$$

$$(a3.12) \quad y.U.t.[1-\beta(1-p)] + \hat{g} \cdot \beta \cdot (1-p) \geq \hat{g} \cdot (1-\beta p) + \beta pyUt$$

$$(a3.13) \quad y.U.t.[1-\beta(1-p) - \beta p] \geq \hat{g} \cdot (1-\beta p - \beta(1-p))$$

$$(a3.14) \quad y.U.t.[1-\beta] \geq \hat{g} \cdot (1-\beta)$$

$$(a3.15) \quad y.U.t \geq \hat{g}, \text{ which equals (31).}$$

Chapter 4

The democratic factor in the education-growth relationship: a possible resolution of the micro-macro paradox

Abstract

This chapter analyses empirically whether the degree of democracy of the political system interacts in the education-growth relationship. Different measures of education are used (expenditure and years of schooling) in panels of data analysed using Arellano and Bover's (1995) and Blundell and Bond's (1998) system-GMM estimation. The results show that a democratic environment is favourable to the impact of education on economic growth, though democracy may not have a direct impact on growth.

Introduction

The first chapter made the case for the hypothesis that will be tested in this chapter. The consistency of positive effects of education on personal income at the microeconomic level suggests that something similar should happen at the macroeconomic level. As Pritchett (1996, 2001) points out, education externalities, if existent, should make macroeconomic effects greater than microeconomic effects. If education is good for growth, when an individual receives education it should not only increase their productivity and consequently their personal income, but also the spillovers of a more educated and more productive individual should benefit the rest of the economy as well. However, the results obtained at macroeconomic level tend to show that macroeconomic returns to education are lower than the microeconomic returns (in other words, that education has a positive impact on individuals' income, but its effect on macroeconomic growth is less clear). Pritchett (1996) refers to this as the 'micro-macro paradox', because initially, we should expect macroeconomic effects to be at least as important as the microeconomic effects (plus possible externalities).

Following Pritchett (1996, 2001, discussed in the introduction), some political environments can be perverse in that more education does not lead to economic growth, but to private benefits at the expense of social costs. Pritchett does not provide details of the political environments he is thinking of. In chapter 1 I argue that democracy (or the lack of it) reunites the conditions that synthesize that environment, at least for the following reasons: dictatorships are less accountable than democracies and can distort resources aimed at education; the absence of rule of law derived from the arbitrariness of the dictator may discourage investment (with negative effects on the growth potential of the education embedded in the individuals); individuals (and their education) are more likely to be killed or exiled in repressive dictatorships than in democracies; democracies have longer time horizons, which is consistent with the 'technology' of the education process (more on this

below); dictatorships tend to spend part of the educational resources in indoctrination, which is not necessarily economically productive; in some cases dictatorships allocate the division of labour centrally, which can be economically less efficient than the forces of the free market. All these channels were summarised in table 1 of chapter 1.

This chapter presents a possible resolution of the ‘micro-macro’ paradox using democracy as a catalyst for the effect of education on macroeconomic growth: according to the hypothesis that will be tested in this chapter, democracy increases the marginal effect of education on growth, because the channels mentioned above (and summarised in table 1 of chapter 1 as the ‘eight channels’) mean that education in the ‘right environment’ (democracy) is more productive than education in the ‘wrong environment’ (non-democracy). In this sense, the lack of democracy can be interpreted as the ‘perverse environment’ to which Pritchett refers. Therefore, though education can always have a positive impact on personal income, a lack of democracy may prevent the transformation of that private benefit into a social benefit. Moreover, it may work in the opposite direction, giving place to the apparent ‘micro-macro’ paradox.

Addressing this question will shed light on the relevance of education and political institutions to the growth process, and will also help to explain some of the divergence found in the literature. At the same time, the policy implications to be drawn are of paramount relevance: if democracy has indeed a role to play in the education-growth relationship, should not some countries (mainly poor ones) get the ‘right institutions’ before engaging in education spending?

This is consistent with the findings of chapter 3: there, I showed that dictators have an incentive to make the ratio $\left(\frac{g}{y}\right)$ look smaller, so that the perceived gains from democracy look smaller and the individuals who could

benefit from a transition to democracy do not offer the transfers required to produce a political change (the ratio $\left(\frac{g}{y}\right)$ represents the gains in income resulting from additional funds (precisely *w.n* monetary units) spent on education).

The second section presents a simple model to formalise part of the theoretical argument and to motivate the search for empirical evidence, which is done in the third section.

Results from previous research

Aghion, Alesina and Trebbi (2007) test whether the economy's proximity to the world technological frontier³³ increases the positive effects of democracy on economic growth. They test this using interaction terms: they multiply their measure of proximity to the technological frontier by a measure of democracy, and find that the interaction is significant and negative, while the direct effect of democracy on growth is positive. This means that when countries are close to the technological frontier (so the distance decreases), the effect of democracy on growth is positive (the positive direct effect of democracy is greater than the interaction term, which may be zero if the country is in the technological frontier, or very small in absolute terms if the country is close to the frontier). For countries that are far from the technological frontier, the negative interaction term overrides the positive direct effect of democracy, meaning that democracy becomes growth-

³³ To measure the world technological frontier in a particular sector, the authors compute the logarithm of the value added per worker in that sector in different countries. The country with the highest value sets the world technological frontier in that sector. The distance of a country from the technological frontier of one particular sector is calculated on the basis of the difference between the logarithm of its value added per worker in that sector and that of the country that sets the world technological frontier for that sector.

diminishing. Although the effect of democracy on growth has been approached by other scholars before (see chapter 1), Aghion, Alesina and Trebbi (2007) argue that the novelty of their contribution is that no one before has interacted democracy with the economy's proximity to the world technological frontier. The novelty of this chapter is derived in the same way: though previous scholars have observed the effect of education and democracy on economic growth, no one has actually interacted both factors as I do here.

Hanushek and Woessmann (2008) acknowledge that the effect of education on growth depends on other policies and institutions, though they do not refer explicitly to democracy. They show that mapping for education through cognitive skills can account for three times the variation in economic growth than models that use years of schooling to map for education. Using data from different international student achievement tests (in literacy and numeracy), they build a measure of cognitive skills which outperforms years of schooling as an explanatory variable for economic growth. They conclude that this is due to the fact that including years of schooling in the growth regressions implicitly assumes that a year of education produces the same increase in knowledge and skills regardless of the educational system, whereas the cognitive skills actually acquired by the population are a better indicator of the outcome of the education received. For example, differences in the quality of the education establishments or the educational systems of two countries can explain why two individuals with the same number of years of schooling may have different levels of productivity, and therefore have different impacts on economic growth. A particularly relevant feature of Hanushek and Woessmann (2008) is that they use interaction terms between their measure of education and measures of the 'appropriateness' of institutions, which is similar to what I do in this chapter. This leads them to the conclusion that education not only impacts on growth directly, but also that better institutional quality increases the impact of education on growth, which is precisely what I test in this chapter. However, there are a number of considerations to be made when comparing what I do here to Hanushek and Woessmann (2008).

First, Hanushek and Woessmann (2008) do not consider democracy as one of the institutions conducive to growth. Instead, they use trade openness and protection against expropriation. Though I do use trade openness as one of the possible explanatory factors of growth, my main institutional regressor (and the one I interact with education) is democracy. In chapter 1 I explain why I believe that democracy may be a better measure of the appropriate institutional framework for education to have an impact on economic growth.

Second, data on cognitive skills, as measured by Hanushek and Woessmann (2008), is now available for only 77 countries (see Hanushek and Woessmann 2009). On average, the number of countries included in the regressions of Hanushek and Woessmann (2008) is less than half the number of countries included in the regressions of this chapter (additionally, the authors admit that their sample is biased towards developed economies). Even more limiting, the internationally comparable data on cognitive skills is in most cases available as one or two observations per country. In Hanushek and Woessman (2009), the closest that the authors get to a time series analysis is a observation of 15 (rich) countries with two data points (1975 and 2000). This makes it hard to assess whether changes of cognitive skills over time really have an impact on economic growth. The data available allows for the observation of cross-sectional correlations between education and growth, rather than within variations (how changes in cognitive skills affect the rates of growth). Expression (5) in the model of the next section tries to capture the within variation of *GDP* due to changes in education; testing that with 2 data points for 15 rich countries is far from ideal.

Third, the analysis of Hanushek and Woessmann (2008) compares a unique initial year with a unique final year, whereas that of the regressions included in this chapter uses time series including various years. The option to use time series is one of the benefits derived from the relative abundance of the data I use when compared to that used by Hanushek and Woessmann (2008).

These last two considerations were also identified by Barro and Sala-i-Martin (2004) when they conclude, after using a test-scores variable, that “*the overall indication is that the quality of education is far more important for economic outcomes than the years of schooling. Unfortunately, the limited amount of international data on test scores makes it difficult to go further with this analysis*” (Barro and Sala-i-Martin 2004, page 537).

For this reason, the analysis of this chapter becomes all the more relevant: if educational quality is only a proxy for the quality of institutions (as argued by Bosworth and Collins 2003), then including measures of the governing institutions (like democracy) may be better than introducing measures of cognitive skills and arguing that those are the result of the mediating effect of educational quality on years of schooling. In other words, democracy may already include the relevant part of the ‘appropriate’ institutional environment, probably (as concluded by Bosworth and Collins 2003) doing a better job than the ‘educational quality’ that is supposedly embedded in the cognitive skills.

A related (though not equal) approach is taken by Baum and Lake (2003). Their analysis has two steps. First, they estimate a regression of female school enrolment rate on democracy and some controls³⁴. They find that democracy contemporaneously affects the female school enrolment rate. Second, they estimate a regression of GDP per capita growth on some controls, democracy and female secondary enrolment lagged 4 periods, and find that female secondary enrolment positively affects economic growth 4 periods later, while democracy has an insignificant (and negative) effect on economic growth. They interpret these results saying that democracy has no direct effect on economic growth, though it has an indirect effect through education: more democracy increases education (first regression), which in

³⁴ The authors focus on female school enrolment rates because they anticipate that these enrolment rates will be more sensitive to variations in regime type than that of men.

turn increases economic growth (second regression). To measure that indirect effect, the authors multiply the coefficient of democracy in the first regression by the coefficient of female secondary enrolment in the second regression. The indirect effect estimated in this way becomes positive and significant (at 10%) only for countries with a GDP per capita above US\$ 2500. However, this does not explain how democracy intervenes in the impact of education on growth; in this model the effect of education on growth is not affected by democracy. In turn, Baum and Lake's (2003) contribution is to provide a causal chain through which democracy may affect growth via a quantity effect: more democracy means more education (though the idea that democracy affects education contemporaneously is questionable), which some periods later is translated into more growth. All this also has the caveat that the results are only significant for countries above a certain threshold of GDP per capita, and that it is only tested for female secondary enrolment.

Benchmark model

In this section I present a simple model to show the effects of piracy on the education-growth relationship. This model is original and I am not aware of previous models trying to formalise the same idea.

I assume an economy in which individuals can obtain their income from working in activities that generate value. The value they generate from their work depends positively on the level of public human capital, referred to as h . I will operationalise this concept later in the chapter; in the meantime let us assume that h is a measure of average human capital in the society. Therefore, for each individual

$$(1) \quad y_i = y(h)$$

where “ y_i ” is the income of each individual, which depends positively on the level of public human capital. The individuals that obtain their income from work are called ‘workers’. Given that there is a unique h for the whole economy, all the individuals have the same income ($y_i = y_j, \forall i, j$), so I just refer to the level of individual income as y . I focus on the income of one period and assume that the income of the previous period is fixed and given, so the determination of y in this period *given* the income of the previous period implicitly determines the rate of growth.

Alternatively, individuals can obtain their income from ‘piracy’, that is, from stealing, asking for bribes, or engaging in corruption, blackmailing or different illegal activities (such as breach of copyrights, piracy, etc). These individuals (herein called ‘pirates’) get hold of a portion of the workers’ income.

The size of that portion (λ) depends on the ability of these pirates, which in turn depends positively on the level of public human capital. This means that pirates benefit from education through two channels: on one hand, education increases the income of the workers, so the pirates have more to steal from. On the other hand, education makes the pirates more skilled, so they can increase the portion of the worker’s income that they can grab (λ). However, there are costs attached to this kind of illegal activity. These costs cover a wide range of punishments: fines, prison, moral costs, etc. Therefore, the net income of a pirate can be expressed as

$$(2) \quad P_i = \frac{\lambda(h) \cdot \sum_1^m y(h)}{n-m} - R_i$$

where I assume that there are m workers in a total population of n individuals (so there are $n-m$ pirates) and R represents all the costs related to piracy. The expression $\lambda(h)$ means that λ depends positively on human capital. I assume

that each pirate gets a similar share of the total loot, so the total amount extracted from the workers gets divided equally among the $n-m$ pirates.

Note that in (2) R has a subindex i meaning that each individual perceives different costs from engaging in piracy. There may be various reasons for this: for example that different individuals assign different values to the probability of being caught, or that individuals with abilities in different fields face different regulations, or that some individuals may feel that they have political or judicial contacts to help them avoid being penalised.

Each individual will choose between becoming a worker or a pirate according to the direction of the following inequality

$$(3) \quad y \cdot (1 - \lambda) >< \frac{\lambda \cdot \sum_{i=1}^m y}{n - m} - R_i$$

(where (h) has been omitted for simplicity). In expression (3), the left hand side reflects the income of a worker net of the pirates' extractions, and the right hand side reflects the income of a pirate as expressed in (2). Rearranging, (3) becomes

$$(3') \quad R_i >< y \cdot \left[\lambda \cdot \left(\frac{m}{n - m} + 1 \right) - 1 \right]$$

Expression (3') says that individuals who perceive higher costs from piracy will become workers, whereas those that perceive lower costs will become pirates. Consequently, in societies where the law is perceived to be enforced more rigorously (and so the costs of piracy tend to be higher), there will be fewer pirates than in those where there is a general perception of anarchy. At the same time, the higher is λ , the more attractive is piracy as an option for individuals.

I refer to the total income of the economy as its *GDP*. As the pirates do not generate new income but just redistribute existing income, the *GDP* of this economy can be calculated as

$$(4) \quad GDP = m.y$$

Expression (4) takes into consideration that all the workers earn the same income ($y_i = y_j, \forall i, j$). From (4),

$$(5) \quad \frac{\partial GDP}{\partial h} = \frac{\partial y}{\partial h} . m + \frac{\partial m}{\partial h} . y$$

Expression (5) means that when the level of human capital changes, *GDP* changes for two factors: first, educated individuals earn more when the society is more educated, and second, the number of individuals choosing to become productive workers (m) may change as a result of the additional public human capital.

To be able to solve (5), I need to calculate $\frac{\partial m}{\partial h}$, and for that, I need an expression for m . From expression (3'), I refer to R^* as the value of R_i that leaves an individual indifferent between becoming a pirate or a productive individual. R^* is then

$$(6) \quad R^* = y \cdot \left[\lambda \cdot \left(\frac{m}{n-m} + 1 \right) - 1 \right]$$

Rearranging,

$$(7) \quad m = n \cdot \left[\frac{(1-\lambda) \cdot y + R^*}{y + R^*} \right]$$

When h increases, so do y and λ . Starting from a scenario where the agent is indifferent between being a pirate and being productive, I look at what

change in h is needed to make the agent change his position either towards becoming a pirate or a productive worker. I answer this question by changing h minimally in the neighbourhood of R^* (R^* is held constant) and analyse the effects of a marginal change of h on m . Therefore, leaving R^* fixed and analysing the effects of a marginal change of h on m , expression (7) shows that an increase in h will have a negative effect on m : while y increases both in the numerator and denominator of (7), λ also increases, so $(1-\lambda)$ decreases, which means that the numerator either decreases or increases less than the denominator (this depends on whether the effect of h on y or on $(1-\lambda)$ is the greater)³⁵. In consequence,

$$(8) \quad \frac{\partial m}{\partial h} < 0$$

With (8), I can re-express (5) as

$$(9) \quad \frac{\partial GDP}{\partial h} = m \cdot \frac{\partial y}{\partial h} + y \cdot \left\{ \frac{\partial m}{\partial h} < 0 \right\}$$

In terms of the literature discussed above, the more ‘perverse’ the educational environment, the more piracy benefits from education. In terms of this model, this means that an increase in h will have a greater impact on λ , which, according to (7), makes the negative effect of (8) stronger. This, according to (9), decreases the effect of education on GDP and increases the likelihood that the negative term in the right hand side of (9) dominates over the first positive term in the right hand side, making the total effect of education expenditure on GDP negative.

³⁵ An alternative way to see this is as follows: for the individual who is indifferent between becoming a pirate or becoming a worker, an increase in human capital means that he will only remain indifferent if m falls. Assume for a moment that m does not fall when the general level of human capital increases: in this case, (3') shows that piracy will be more rewarding than working (the right hand side of (3') increases over the left hand side, because y and λ increase with education). Therefore, in this case, the individual who was previously indifferent becomes a pirate, which means that m falls.

The first term on the right hand side of expression (9) implies that the greater the number of people in the working sector (the greater m), the greater the impact of education on GDP . In other words, for a given $\frac{\partial y}{\partial h}$, more people involved in piracy means a lower impact of education on GDP . This is the effect to which I refer above (after expression (5)) as ‘first factor’. For all the reasons mentioned in chapter 1, democracies can be expected to be better than non-democracies at enforcing the law, respecting property rights, fighting corruption and respecting human rights. This means that on average, individuals living under democracy will perceive higher costs (R_i) from engaging in piracy. Additionally, if a democratic government has a genuine interest in the well-being of the majority of the population as opposed to just that of a group or elite, they will do what is necessary to increase aggregate GDP . In this model, this requires increasing the perceived costs of piracy (R_i), which increases m .

This model not only addresses the issue of how democracies can increase the impact of education on growth. It also addresses the micro-macro paradox to which I previously refer: whereas at microeconomic level both workers and pirates benefit from more education (and depending on the functional form of λ , pirates may even benefit more than workers), at macroeconomic level the impact of education can be lower than at microeconomic level. For instance, if $m < n$ (so pirates exist) and the institutional environment is such that education has a relatively strong effect on the extractive abilities of the pirates, then (9) shows that the effect of education on GDP is smaller than that on individual incomes.

If there is no piracy, then the addition of the micro effects for the n individuals should be equal to the macro effects. From (1), it is straightforward that

$$(10) \quad \sum_1^n \frac{\partial y}{\partial h} = n \cdot \frac{\partial y}{\partial h}$$

which is the addition of individual incomes. If there is no piracy, then $n=m$, so expression (4) becomes

$$(11) \quad GDP = n \cdot y$$

from where

$$(12) \quad \frac{\partial GDP}{\partial h} = \frac{\partial y}{\partial h} \cdot n$$

It is straightforward to see that expression (10) equals expression (12), which means that when there is no piracy, the macroeconomic effect of education on *GDP* equals the sum of the microeconomic effects on individuals' incomes. This shows that in the absence of piracy, there is no macro-micro paradox, whereas piracy brings in the discrepancy of the effects of education at micro and macro level.

Data and results

In this section I present empirical evidence to test the hypothesis that democracy plays a role in the education-growth relationship, in the sense that more democracy means that education has a greater impact on growth. Addressing this hypothesis will shed light on the relevance of education and political institutions to the growth process, and will also help to explain some of the divergence found in the literature. At the same time, the policy implications to be drawn are of paramount relevance: if democracy has indeed a role to play in the education-growth relationship, should not some countries (mainly poor ones) get the 'right institutions' before engaging in education spending?

Empirically, I test this using interaction terms. I run regressions where the dependent variable is growth in GDP per capita, and among the explanatory variables there is a measure of education, a measure of democracy, and the product of both (the interaction term). An interaction term with a positive coefficient means that more democracy enhances the positive impact of an additional unit of education on growth. In other words, an interaction term with a positive coefficient means that the marginal product of education increases with democracy.

I use two proxies for education: one is an input of the education process (public expenditure on education) and the other is the average years of schooling of people aged 15 and more. This means that the variable h of the model of the previous section is proxied here by the level of public expenditure in education and by the average years of schooling. A third alternative to operationalise h could be to use a measure of cognitive skills, as in Hanushek and Woessman (2008). I do not use their measure of cognitive skills to operationalise h for the reasons that I discussed before.

Growth, democracy and public expenditure on education

The data used to test the relationship between public expenditure in education and growth under different degrees of democracy consists of a panel of 116 countries for the period 1980-2003. I average the data over non-overlapping three-year periods (1980-1982, 1983-1985, 1986-1988, 1989-1991, 1992-1994, 1995-1997, 1998-2000, 2001-2003).

The arising dataset is an unbalanced panel consisting of 116 countries over 8 periods. The sources of data are presented in appendix 1; the list of countries is presented in appendix 2 under the heading 'Group 1: All countries'; descriptive statistics for the variables used in this section are presented in appendix 3.

I estimate variations of the following equation;

$$(13) \ln GDP_{pc}Growth_{i,t} = \beta_0 + \beta_1 \ln GDP_{pc}_{i,t-1} + \beta_2 PubEducExpend_{i,t-1} + \beta_3 PubEducExpend_{i,t-4} + \\ + \beta_4 Democracy_{i,t-1} + \beta_5 Democracy_{i,t-4} + \beta_6 [PubEducExpend * Democracy]_{i,t-1} + \\ + \beta_7 [PubEducExpend * Democracy]_{i,t-4} + [Controls_{i,t}]' \cdot \delta + v_i + v_t + v_{i,t}$$

where $\ln GDP_{pc}_{i,t}$ stands for natural logarithm of real GDP per capita of country i in period t , $\ln GDP_{pc}Growth$ stands for the natural logarithm of the growth of real GDP per capita (period over previous period), $PubEducExpend$ stands for public expenditure in education as a share of GDP, and $Democracy$ is a measure of democracy (where 1 is totally democratic and 0 is totally nondemocratic, see appendix 1 for details on this measure of democracy)³⁶. $[Controls]$ represents a vector of five control variables: total public expenditure as a share of GDP, investment as a share of GDP, the percentage of population between 15 and 64 years in the total population, annual inflation rate, and a measure of trade (exports plus imports, over GDP).

The GDP per capita lagged one period controls for conditional convergence, while the measures of education and democracy enter with different lags to test for short and long-run effects. The reason for the different lags is that for education expenditure to have an impact on growth, the expenditure has to be undertaken, then be ‘transformed’ into education (expenditure in education is an input in the education process) and finally the individuals that receive that education have to enter the labour market. This is not an instantaneous process, so I test different possible lags for this effect to occur (Sylwester 2000 considers the effects on economic growth of different

³⁶ Though an institutional measure, the variation of the variable *Democracy* should not be underestimated: the descriptive statistics in appendix 3 show that this variable varies relatively more than most of the other variables included in the analysis (the comparison is made using the coefficient of variation). This is true not only for the ‘overall’ but also for the ‘within’ variation, which observes the variation of each county’s values around their own mean.

lags of education and finds that different lags have different effects). This is discussed and tested below.

The simultaneous determination of growth and lagged GDP per capita biases the fixed-effects estimation of (13). Additionally, previous research (Bond, Hoeffler and Temple 2001) has shown that the first-differenced GMM estimator developed by Arellano and Bond (1991) tends to behave particularly poorly in growth equations that include a low number of periods (the lagged levels of the variables are weak instruments for first-differences). Similarly, Castelló-Climent (2008) stresses that fixed effects and first difference GMM might not be appropriate when variables are persistent over time (which is what she observes in her democracy and education data, but it is also what Bond, Hoeffler and Temple 2001 expect from growth regressions, given the persistency of output). This is because when variables vary significantly across countries but remain stable within countries, taking the first differences eliminates most of the variation in the data (which comes from the variability across countries). For that reason, including a regression in levels the system GMM estimator incorporates the cross-country variation. Consequently, I estimate equation (13) using a system-GMM estimator, as developed by Arellano and Bover (1995) and Blundell and Bond (1998).

However, in order to check whether first-differences would also bias the results in this case, I follow Bond, Hoeffler and Temple (2001). They estimate their growth equation using different methods (OLS, fixed-effects, first-difference GMM and system-GMM) and obtain a coefficient on lagged income from first-difference GMM that lies below that obtained from a fixed-effects estimation (which they expect to be downward-biased). They conclude that this provides evidence that the first-difference GMM estimate of the coefficient of lagged income is biased, whereas when the coefficient is estimated using system-GMM estimation, its value lies above the downward-biased first-difference and below the upward-biased OLS. From this, they

conclude that the system-GMM yields an improvement in precision compared to the first-difference GMM.

To reproduce the steps followed by Bond, Hoeffler and Temple (2001), I estimate four different specifications (which are detailed in table 2) using Ordinary Least Squares (OLS) and fixed-effects, and compare the coefficient on lagged income (*lnGDPpc*) with that obtained using difference GMM (Arellano and Bond 1991). The results obtained for the coefficient on lagged income are reported in table 1.

Table 1

Coefficient for lagged ln of GDP per capita

Dependent variable: ln of GDP per capita growth (period over previous period)

	(1)	(2)	(3)	(4)
OLS	-0.0119	-0.0129	-0.0139	-0.0114
Fixed effects	-0.4269	-0.4278	-0.4382	-0.4596
Difference GMM	-0.4158	-0.4171	-0.4322	-0.4913
System GMM	-0.0203	-0.0166	-0.0224	-0.0159

The four columns correspond to the four specifications of table 2. System-GMM is instrumented with levels lagged two and three times in the differences equation and first-differences lagged once as instruments in the levels equation. Difference GMM is instrumented with levels lagged two and three times, except in the first equation, where it is instrumented with levels lagged three and four times.

In table 1 I follow the same steps than Bond, Hoeffler and Temple (2001) and obtain results that are aligned with theirs: when estimated by difference GMM, the coefficient of lagged income is close to or below the coefficient estimated using fixed effects, suggesting a bias in difference GMM³⁷. In all four specifications, the estimation by system-GMM yields coefficients for *lnGDPpc* that are between those estimated by OLS and by fixed-effects estimation. Considering these results and the recommendations

³⁷ In the first three specifications, the coefficient from first-difference GMM is not strictly below those of the fixed-effects estimation (although they are relatively close); in the fourth specification, the coefficient from first-difference GMM is below that of the fixed-effects estimation.

found in the literature (above), I use system-GMM estimation for the regressions presented in the rest of the chapter.

While in Arellano and Bond's (1991) first-differenced GMM estimator the endogenous and predetermined variables are instrumented with lags of their own levels, the system-GMM estimator combines those equations with an additional set of equations in levels with lagged first-differences as instruments. In this case, equation (13) is instrumented using levels lagged two and three times in the differences equation, and first-differences lagged once as instruments in the levels equation.

Table 2 shows the estimations obtained with different specifications. The Hansen test and the Arellano-Bond test for AR(2) do not suggest the presence of problems with the choice of instruments or the specification of the models. Following Bloom, Bond and Van Reenen (2001), a goodness of fit measure is provided, calculated as the squared correlation between the predicted growth in GDP per capita and the actual growth in GDP per capita. This squared correlation between actual and predicted variables is equivalent to the standard R^2 for OLS. However, in this context the interpretation of this measure has to be taken with caution, as the objective of instrumentation is, in a way, to reduce the explanatory power of the model by removing potentially endogenous variation in the regressors.

As mentioned above, I do not expect public money spent on education to have a positive effect on per capita GDP growth in the short run. Education expenditure is just an input in the education process: this expenditure has to be converted into an educational output (abilities, skills) through the education technology, which later has to be put into practice in the labour market. For this reason, a reasonable assumption is that money spent today in education will have a positive impact on GDP only in the future, whereas in the short run it acts as expenditure with no positive effects.

Dependent variable: *ln of GDP per capita growth (period over previous period)*

	(1)	(2)	(3)	(4)
ln of GDP per capita (1 lag)	-0.020317 ** (-2.33)	-0.0165523 * (-1.83)	-0.0223878 ** (-2.44)	-0.0159306 (-1.45)
Trade/GDP	0.0001123 (0.47)	0.0001031 (0.46)	0.0002053 (0.93)	0.0001004 (0.39)
Annual inflation rate	-0.0004420 (-1.39)	-0.0003998 (-1.28)	-0.000392 (-1.32)	-0.000496 (-1.25)
Public expenditure/GDP	0.0025139 (1.11)	0.0015714 (0.69)	0.0022357 (1.01)	0.0015503 (0.67)
Investment/GDP	0.0061852 *** (6.30)	0.0062208 *** (7.16)	0.0063528 *** (6.77)	0.0062034 *** (6.00)
Population 15-64 years/Total population	0.0062086 *** (3.09)	0.0053006 *** (2.83)	0.0061624 *** (3.27)	0.0052842 *** (2.97)
(a) Public education expenditure/GDP (1 lag)	-0.024425 *** (-3.40)	-0.020564 (-1.29)	-0.0228263 *** (-3.84)	-0.0216 *** (-3.23)
(b) Public education expenditure/GDP (4 lags)	0.005824 *** (4.50)	0.001766 (0.61)	0.0034009 ** (2.19)	0.0034209 * (1.82)
(c) Democracy (1 lag)	0.0040912 (0.13)	0.0078333 (0.10)		
(d) Democracy (4 lags)	0.0388487 (1.35)	-0.0425651 (-0.95)		
Interaction (a) and (c) (1 lag)		-0.0018478 (-0.10)		
Interaction (b) and (d) (4 lags)		0.0189237 ** (1.98)	0.0105115 ** (2.06)	0.0170143 ** (2.56)
Arellano-Bond test for AR(2) in first diff. (p-value)	0.505	0.649	0.589	0.329
Hansen test (p-value)	0.224	0.546	0.430	0.589
Goodness of fit	0.334	0.369	0.353	0.387
Countries	116	116	116	90
Observations	348	348	348	257

Notes: t-values in parenthesis. *** stands for significant at 1% level, ** significant at 5%, * significant at 10%.

System GMM instrumented with levels lagged two and three times in the differences equation, and first-differences lagged once as instruments in the levels equation.

Table 2

This expectation is corroborated by Sylwester (2000), who showed that “*Although public education expenditures are positively associated with future economic growth, the contemporaneous effect upon growth is negative*” (Sylwester 2000 page 379). For this reason, I introduce the measure of public education expenditure (Public education expenditure/GDP) lagged one and four periods (equivalent to 3 and 12 years respectively), trying to capture the different effects of different time lags.

The series of public education expenditure are not very long (there are only sufficient data back to 1980), so it is not possible to introduce many lags and still have long enough series. For that reason, I limit the analysis here to 4 lags.

The results obtained corroborate the expectation regarding the length of the lags of the education expenditure variable: ‘Public education expenditure/GDP’ appears with a negative coefficient when lagged one period but with a positive coefficient when lagged four periods.

In the first specification, both coefficients for education expenditure are significant at 1% level. For the democracy variable, neither of the lags appears significant at 10% level. The negative sign on the lagged level of GDP per capita (which is significant at 5% level) suggests that there is some degree of conditional convergence operating. The controls ‘Investment/GDP’ and ‘Population 15-64 years/Total population’ are significant at 1% and have the expected positive sign, meaning that countries that invest more and have a younger population grow faster than those that do not. The other three controls are not significant.

The five controls are consistent across the four specifications in the sense that they neither change sign or their level of significance. I include a measure of trade, inflation, and investment/GDP to control for some of the standard regressors in the growth literature (see a discussion in Yi Feng 1997

or Barro and Sala-i-Martin 2004). I also control for (public expenditure/GDP) and (population of 15-64 years/total population) for reasons that are more specific to the factors analysed here. First, as public education expenditure/GDP is one of the key regressions in table 2, controlling for public expenditure/GDP becomes relevant. A country that spends relatively more public money in general will probably spend more on education too. Given that a greater total public expenditure may also affect economic growth, only observing the effects of higher public expenditure on education without leaving total public expenditure constant would bias the estimate of the effects of education expenditure on growth. Second, I include a control to account for the age structure of the population (population of 15-64 years/total population) to check whether the effect of education expenditure on growth may not be just a result of different age structures of the populations across countries, such that 'younger countries' grow faster and also need to spend more money on education because of their age structure.

In the second specification I add two interaction terms: the product of democracy and the measure of public education expenditure, lagged one and four periods (again, equivalent to 3 and 12 years respectively). While the interaction term lagged 1 period does not have a significant coefficient, when lagged 4 periods the coefficient is significant at 5% level. An interesting result is that when both interaction terms are added, both lags of the education expenditure variable cease to be significant (though they maintain their sign).

In the third specification I remove the democracy variables (which did not appear with a significant coefficient in the first two specifications) and the first lag of the interaction term. The result is that both lags of the education expenditure variable become significant again (at 1% level for 1 lag and 5% level for 4 lags), while the interaction term with 4 lags remains significant at 5% level.

A positive and significant interaction term means that the effect of education expenditure on growth is amplified with more democracy: the marginal effect of public education expenditure on growth depends on the level of democracy, so more democracy means that each pound spent on public education has a greater impact on growth. This means that public education expenditure affects GDP per capita growth directly and indirectly: directly, it has a long-run effect (positive) and a short-run effect (negative); indirectly, it has a positive effect through the political system in the long-run (the interaction term).

To assess the economic significance of the interaction term, let us consider a country with the average level of Public Education Expenditure/GDP and the average level of democracy. According to appendix 3, the mean of Public Education Expenditure/GDP is 0.4525 and the average level of democracy is 0.5984, so Mexico in the period 1992-1994 is an example of a country with values relatively close to the average levels of both variables. From this point, and using the third specification of table 2, if democracy increases by one standard deviation (0.3628), this country would experience a 1.70 percentage points higher GDP per capita growth rate four periods later³⁸. The growth rate considered refers to the logarithm of GDP over that of the previous period (where one period is the average of 3 years), so the referred 1.70 percentage points are an approximation for an increase in the growth rate over 3 years. Annualising this 3-year increase in the growth

³⁸ This result comes from the following computation:

(a): Value of the interaction term *before* the increase in democracy:
 $Interaction\ coefficient * (Average\ Education\ Expenditure/GDP) * Average\ Democracy = 0.0105 * 4.4525 * 0.5984 = 0.0280$

(b): Value of the interaction term *after* the increase in democracy:
 $Interaction\ coef * (Average\ EducExp/GDP) * (Average\ Democracy + 1\ Std\ Deviation) = 0.0105 * 4.4525 * (0.5984 + 0.3628) = 0.0450$

Finally, the increase in the interaction term is $(b) - (a) = 0.0450 - 0.0280 = 0.0170$

rate yields a yearly increase of 0.56 percentage points, which is economically significant.

An alternative way to assess the economic significance of the interaction term would be to consider the case of a country with the average level of Public Education Expenditure/GDP that moves from absolute lack of democracy (*Democracy=0*; Bahrain in 1986-1988 is an example of a country with this combination of values) to perfect democracy (*Democracy=1*; Spain in 1992-1994 is an example with this combination of values): in this case, the country would observe a 4.68 percentage points higher GDP per capita growth rate four periods later. Again, the 4.68 points apply for a period of 3 years over the previous period, so the annualised equivalent is an increase in the yearly growth rate of 1.54 percentage points. This is a significant effect from an economic point of view.

The result obtained for the interaction term means that different political contexts translate into different impacts of education expenditure on growth. In a way, this supports Pritchett's (1996) 'piracy' argument: in certain environments (in this case, non-democratic ones) more education could mean more pirates, which erode the potential benefits of education on the economy through a diversion of resources. This could also help explain the divergence in micro and macro returns to education in cross-country regressions (Krueger and Lindahl 2001): though education is generally associated with increased personal earnings, it may have different impacts on economic growth depending on the institutional settings.

To check whether the results obtained are driven by the richest countries, I re-run the third specification of table 2 removing the high-income countries from the sample. The 'high income' countries were those defined as

such by the World Bank³⁹. The resultant ‘no rich’ countries are listed in appendix 2, under the title ‘Group 2: no rich subset’. The result of re-running model 3 for this particular subset is shown in column 4 of table 2. Column 4 shows that the results do not change dramatically when excluding the richest countries from the sample.

Observing this relationship for the least rich countries is particularly relevant because those are the countries that have more to gain from the interaction term. This is because the poorest countries transfer less resource to education (see chapter 2) and have worse democratic performances (see for example Acemoglu, Johnson and Robinson 2004).

The next subsection checks the robustness of this claim using a different proxy for education.

Growth, democracy and years of schooling

In this subsection I use average years of schooling as a proxy for education. Using this variable avoids the criticism that some researchers have made of the power of education expenditure to explain economic growth. Particularly, the creators of the dataset from which I obtain the education achievement data (Barro and Lee 1993, 2000) show that this indicator of education attainment explains economic growth better than previous proxies for human capital. The advantages and disadvantages of this variable when compared to Hanushek and Woessman’s (2008) cognitive skills variable were discussed earlier in this chapter.

³⁹ See

http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0..contentMDK:20421402~pagePK:64133150~piPK:64133175~theSitePK:239419.00.html#High_income

As mentioned above (and in chapter 1, table 1), one of the reasons why education expenditure may not promote growth in non-democracies is that in this kind of regime the ruling elite can divert expenditure in education to favour themselves, subsidizing for example higher education for a minority even in contexts of high illiteracy. A second reason is that although corruption is present in both democracies and non-democracies, the accountability of a democratic system is higher than that of a non-democracy. In fact, there is evidence that in some countries a large share of government spending in education is not actually going to education (Chaudhury, Hammer, Kremer, Muralidharan and Rogers 2006; Duflo and Hanna 2005). If these factors are indeed playing a role, then for a given expenditure in education one can expect a higher education attainment in democratic countries than in non-democracies. In other words, it may not be a matter of quality of data, but just that Barro and Lee's (1993, 2000) dataset has a smaller mediating effect of democracy in the education-growth relationship. However, if the mediating effect of democracy is strong enough (as my hypothesis suggests) then this effect should also occur through Barro and Lee's indicator of educational attainment.

The data used to test the relationship between years of schooling and growth under different degrees of democracy consists of a panel of 103 countries for the period 1960-2004. I average the data over non-overlapping five-year periods (1960-1964, 1965-1969, 1970-1974, 1975-1979, 1980-1984, 1985-1989, 1990-1994, 1995-1999, 2000-2004). The averages are taken over five-year periods because the data is only available every five years, so there is no way to obtain shorter periods.

The arising dataset is an unbalanced panel consisting of 103 countries over 9 periods. The sources of data are presented in appendix 1; the list of countries is presented in appendix 2 under the heading 'Group 3: All countries'; descriptive statistics for the variables used in this section are presented in appendix 4 (the descriptive statistics are different to those

presented in the last section because the time periods are different and the set of countries is different).

I estimate variations of the following equation;

$$(14) \ln GDPpcGrowth_{i,t} = \beta_0 + \beta_1 \cdot \ln GDPpc_{i,t-1} + \beta_2 \cdot GrowthAvYearSch_{i,t} + \beta_3 \cdot Democracy_{i,t} + \beta_4 \cdot [GrowthAvYearSch * Democracy]_{i,t} + [Controls_{i,t(i,t-1)}]' \cdot \delta + v_i + v_t + v_{i,t}$$

where $\ln GDPpc_{i,t}$ stands for natural log of real GDP per capita of country i in period t , $\ln GDPpcGrowth$ stands for natural log of growth of real GDP per capita (in percentage points), $GrowthAvYearSch$ stands for the growth of the average years of schooling for people of 15 years of age and more, and $Democracy$ is the same measure of democracy that was used previously. $[Controls]$ represents a vector of four control variables: investment as a share of GDP, population between 15 and 64 years as a share of total population, annual inflation rate and a measure of trade (as previously).

Though the structure of this equation is similar to that of equation (13), there are some changes that need to be explained.

First, total public expenditure as a share of GDP is now excluded from the set of controls. The reason is that equation (13) measures the effect of public education expenditure on per capita GDP growth, so there, controlling for total public expenditure makes sense: a country that spends relatively more public money in general will likely spend more on education too. Equation (14) does not measure the effect of public education expenditure on growth, so controlling for total public expenditure is no longer relevant.

Second, while the measure of education is lagged in equation (13), in equation (14) it is not lagged. There are at least three reasons for this. First, the measure of education in equation (13) is calculated for each period, whereas for equation (14), the growth in the years of schooling implicitly

incorporate two different periods. Second, the length of the periods in this regression is longer than in the previous one (5 years per period versus 3 years per period), so when considering the growth on the average years of schooling I am covering a longer number of years than before. Third, the reasons that justify lagging public education expenditure in a growth equation do not stand to support lagging the growth in the average years of schooling. When I lagged the public education expenditure I argued that education expenditure is only an input in the education process, meaning that the expenditure has to be converted into an educational output through the education technology in order to be put into practice in the labour market. However, the average years of education are already an output of the education system which can readily increase the performance of labour as a productive factor in the economy. For this reason, I do not lag the growth in the average years of schooling.

Third, whereas Democracy was lagged one and four periods in equation (13), it appears without lags in equation (14). This is a direct consequence of the second difference just explained. The measure of democracy must be contemporaneous with the measure of education in order to capture any interaction effects; since in equation (14) the measure of education is not lagged, then the measure of democracy is not lagged either.

Fourth, equation (13) included the population between 15 and 64 years of age as a share of total population among the regressors, and this variable was not lagged. Now, this variable is lagged one period. This is because the role of this control variable changed when compared to equation (13). In that case, the main regressor was public expenditure on education, which covered individuals of different ages (total expenditure in education comprises primary, secondary and tertiary education), so the role of the population variable was to control for different structures of the population. In contrast, in equation (14) the main regressor is the growth of average years of schooling for people of 15 years of age and more. In order to assess the impact of an increase in the years of schooling of that age group on the growth of GDP per

capita, I control for the initial relative size of the population between 15 and 64 years of age, which is the group in which I expect that a change in the average years of education will have a greater impact on the growth of GDP per capita.

Finally, whereas equation (13) is instrumented using levels lagged two and three times in the differences equation and first-differences lagged once as instruments in the level equation, equation (14) is instrumented using levels lagged three and four times in the differences equation and first-differences lagged twice as instruments in the level equation. The reason for this can be found in table 3: for all the specifications, the Arellano-Bond test for AR(2) in first differences rejects the null of no second-order autocorrelation in differences, while the same test for AR(3) fails to reject the null of no third-order autocorrelation in differences.

Table 3 shows the results for this set of regressions, in which the AR(3) tests and the Hansen tests do not show evidence of problems with the choice of instruments or the specification of the models.

Dependent variable: ln of GDP per capita growth (period over previous period)

	(1)	(2)	(3)	(4)	(5)
ln of GDP per capita (1 lag)	0.0036082 (-0.21)	-0.001158 (-0.06)	-0.0021774 (-0.10)	0.0097958 (0.39)	0.0076133 (0.32)
Trade/GDP	-0.0000122 (-0.04)	-0.0000343 (-0.11)	0.0001533 (0.49)	0.0000211 (0.06)	0.0003425 (1.02)
Annual inflation rate	-0.0000742 *** (-3.48)	-0.0000666 *** (-3.07)	-0.0000718 *** (-2.94)	-6.65E-05 *** (-2.71)	-6.87E-05 *** (-2.77)
Investment/GDP	0.0052345 ** (2.47)	0.0051947 ** (2.10)	0.00490 ** (2.47)	0.0046097 * (1.89)	0.0031012 (1.39)
Population 15-64 years/Total population (1 lag)	0.0052061 (1.15)	0.0055019 (1.24)	0.0041655 (0.77)	0.0048542 (0.93)	0.0069378 * (1.68)
(a) Growth of average years of schooling of individuals aged 15 years and more	-0.0017292 (-1.61)	-0.002331 * (-1.86)			
Democracy	0.0322647 (0.69)		0.0904738 (1.63)		
Interaction terms: Democracy and (a)	0.0041327 * (1.73)	0.0062543 ** (2.07)	0.001903 * (1.67)	0.0038769 ** (2.15)	0.0028294 ** (2.03)
Arellano-Bond test for AR(2) in first diff. (p-value)	0.000	0.000	0.000	0.001	0.003
Arellano-Bond test for AR(3) in first diff. (p-value)	0.441	0.720	0.231	0.395	0.116
Hansen test (p-value)	0.842	0.358	0.573	0.346	0.810
Goodness of fit	0.279	0.261	0.271	0.255	0.245
Countries	103	103	103	103	74
Observations	656	656	656	656	461

Notes: t-values in parenthesis. *** stands for significant at 1% level, ** significant at 5%, * significant at 10%.

System GMM instrumented with levels lagged three and four times in the differences equation, and first-differences lagged twice as instruments in the levels equation.

Table 3

In all the specifications the control for annual inflation has the expected negative sign and is significant at 1%. The control for investment/GDP has the expected positive sign in all the specifications and is significant at 5% in the first three specifications, is significant at 10% in the fourth specification, and is not significant in the fifth specification. The other two controls are not significant in any of the specifications, with the exception of population of 15-64 years of age/Total population, which is significant at 10% in the fifth specification.

In the first specification I include the interaction term and its two components. Whereas both components are insignificant, the interaction term itself is positive (as expected) and significant at 10% level. In the second and third specifications I remove each of the components (one at a time) of the interaction term.

In the second specification the interaction term (positive and significant at 5%) enters with the growth of average years of schooling of individuals aged 15 years and more. This last variable appears with a negative sign and is significant at 10%. This has an interesting interpretation: for low levels of democracy ($0 \leq Democracy < 0.373$) the direct effect of the average years of schooling prevails, so an increase in the average years of schooling has a negative net impact on GDP per capita growth, whereas for $0.373 < Democracy \leq 1$, the interaction term prevails and the net impact on GDP per capita growth of an increase in the average years of schooling is positive. This means that for low levels of democracy an increase in education is detrimental for the economy, probably due to 'piracy' in Pritchett's sense.

In the third specification the interaction term (positive and significant at 10%) enters with democracy. This last variable is positive but insignificant.

In the fourth specification I remove both components of the interaction term; the interaction term appears significant at 5% level.

To assess the economic significance of the interaction term, I proceed in the same way as in the previous sub-section. Let us consider a country with the average growth of the average years of schooling of individuals aged 15 years and more, and the average level of democracy. According to appendix 4, the mean for the first variable is 11.904 and the mean for the second variable is 0.5859, so Iran in 2000-2004 is an example of a country with values relatively close to the average levels of both variables. From this point, using the fourth specification of table 3, if democracy increases by one standard deviation (0.3674), this country would experience a 1.70 percentage points higher GDP per capita growth⁴⁰. The growth rate considered refers to the logarithm of GDP over that of the previous period (where one period is the average of 5 years), so the referred 1.70 percentage points is an approximation for an increase in the growth rate over 5 years. Annualising this 5-year increase in the growth rate yields a yearly increase of 0.34 percentage points, which is economically significant.

An alternative way to assess the economic significance of the interaction term would be to consider the case of a country with the average growth of the average years of schooling of individuals aged 15 years and more, that moves from an absolute lack of democracy (*Democracy=0*; Brazil in 1970-1974 is an example of a country with this combination of values) to

⁴⁰ This result comes from the following computation:

(a): Value of the interaction term *before* the increase in democracy:

Interaction

$$\text{coef} * (\text{AverageGrowthYearSch}) * \text{AverageDemocracy} = 0.0039 * 11.9044 * 0.5859 = 0.0270$$

(b): Value of the interaction term *after* the increase in democracy:

$$\text{Interaction coef} * (\text{Average GrowthYearSch}) * (\text{Average Democracy} + 1 \text{ Std Deviation}) = \\ = 0.0039 * 11.9044 * (0.5859 + 0.3674) = 0.0440$$

Finally, the increase in the interaction term is $(b) - (a) = 0.0440 - 0.0270 = 0.0170$

perfect democracy (*Democracy=1*; Papua New Guinea in 1995-1999 is an example with this combination of values): in this case, the country would observe a 4.62 percentage points higher GDP per capita growth. Again, the 4.62 points apply for a period of 5 years over the previous period, so the annualised equivalent is an increase in the yearly growth rate of 0.91 percentage points. This is a significant effect from an economic point of view.

These results are consistent with the hypothesis that democracy increases the marginal contribution of education to economic growth. In fact, the results obtained with average years of schooling are similar to the results obtained using the expenditure variable, which adds robustness to the results.

To check whether the results obtained are driven by the richest countries, I re-run the fourth specification of table 3 removing the high-income countries from the sample. The 'high income' countries were defined with the same criteria as above. The resultant 'no rich' countries are listed in appendix 2, under the title 'Group 4: no rich subset'. The result of re-running model 4 for this particular subset is shown in column 5 of table 3. Column 5 shows that the results do not change dramatically when excluding the richest countries from the sample.

Final remarks

The empirical evidence analysed in this chapter supports the hypothesis that democracy has a role to play in the education-growth relationship: the more democratic a country, the greater the expected impact of education on economic growth. This holds in models that approximate education using public expenditure on education as a share of GDP and in models that use a measure of average years of schooling. This suggests that democracy encapsulates the institutional and governance environment that

Pritchett (1996, 2001) understands is required to avoid 'piracy' and to make education an input for economic growth.

This finding has several implications. For future research it means that political institutions and education should not be considered as different inputs or sources of growth; instead, researchers should look at their interactions and synergies. Additionally, it is also possible that democracy affects growth through interactions with other factors, and this should also be investigated by future research.

For policy implementation, the main implication that can be drawn is that the importance of getting the 'right' institutions is greater than previously thought, as institutions affect growth indirectly. This can help define an agenda for policymakers, who according to this finding, will first need to get the *right institutions* before engaging the public finances in further educational efforts.

This does not mean that full democracy is the only institutional condition that makes education conducive to economic growth. On the one hand, in chapter 1 I showed that I take Democracy only to map for a 'cloud of factors' that may be intervening in the education-growth relationship. However, I did not choose Democracy naively among that cloud of factors: I chose it based on the existing literature discussed in chapter 1, and on my belief that democracy itself may be playing a stronger role than the other factors (see the eight channels discussed in chapter 1 and summarised in chapter 1, table 1). On the other hand, the 'East Asian Miracle' of 1966-1995 is an example of countries with above-average increases in schooling and above-average GDP growth, mostly under non-democratic political environments. How does this fit with the findings of this chapter?

Young (1995) analyses four East Asian countries (Hong Kong, Singapore, South Korea and Taiwan) and concludes that their impressive

growth was mostly due to increases in inputs rather than increases in productivity. Bosworth and Collins (1996) extend Young's work (they include Indonesia, Malaysia, the Philippines and Thailand) and conclude in the same direction: productivity growth was not impressive according to world standards, and economic growth was a consequence of a quantity effect (more inputs put into production).

Krugman (1994)⁴¹ argues in the same direction (though probably more dramatically). Krugman compares the experience of the East Asian 'miracle' countries in the period 1966-1994 with that of the Soviet Union in the nineteen fifties, and concludes that in both cases growth was a result of a massive increase in inputs rather than in returns per unit of expenditure. In the case of the Soviet Union, he argues, the authoritarian regime allowed an unprecedented ability to mobilize great amounts of resources and thus fuel growth. In this sense, non-democracy can be conducive to economic growth through the mobilization of physical and human capital (education), though not necessarily to increases in growth per unit of input used. Growth is then the result of a quantity effect. This is consistent with the findings of Pinto and Timmons (2005): "*regimes with more political competition may not grow any faster or slower than less competitive regimes, but they grow differently, relying more on intensive as opposed to extensive growth*" (Pinto and Timmons 2005, page 28).

The fact that the East Asian countries observed by Young (1995) and Bosworth and Collins (1996) did not manage to increase the macro returns of education is consistent with the findings of this chapter for a non-democratic environment. In fact, according to the findings of this chapter, growth would have been even more spectacular in the East Asian countries in the presence of

⁴¹ Krugman's argument borrows heavily from an earlier version of the paper of Alwyn Young to which I refer here (Krugman refers to the version in the NBER, Working Paper 4680, March 1994), and that is why Krugman's paper appears to be previous to Young's. It is not.

the 'right' political institutions. Democracy and the 'cloud of factors' could have brought other 'efficiency enhancing' transformations through the eight channels identified above and the accompanying (causality not implied) improvements in regulatory quality, government effectiveness, property rights, rule of law, corruption, political stability, freer markets, law enforcement and human rights. On top of the direct effect that each could have had on growth, those factors could have made the increased inputs (particularly education) work more efficiently, thus increasing their macro returns and fostering even more growth.

Rodrik (1997) finds that institutional quality "*does exceptionally well in rank-ordering East Asian countries according to their growth performance*" (Rodrik 1997, page 1)⁴². If institutions played a direct role (as he finds), why could they not have also played an indirect role in the way proposed in this chapter? The lack of significant total factor productivity growth in the context of the non-democratic East Asian experience seems to suggest that institutions also have an indirect role to play.

⁴² In the same paper, Rodrik also challenges Young's (1995) and Bosworth and Collins' (1996) findings, suggesting that their conclusions about the 'quantity effect' were a result of their rigid initial assumptions about the production function. Bosworth (in Bosworth and Collins 1996) shows that their initial assumptions are consistent with the empirical evidence available. The reason why Bosworth's answer in 1996 seems to be previous to Rodrik's critic in 1997 is because Rodrik anticipated his critic in a comment at the end of Bosworth and Collin's 1996 paper, which Bosworth replied in a comment in the same paper.

Appendix 1: Sources of data

ln of GDP per capita: Natural logarithm of GDP per capita in constant US\$ (year 2000). Source: World Bank, World Development Indicators (WDI) April 2008, ESDS International, (Mimas) University of Manchester.

Public expenditure/GDP: Taken from the variable 'KG' of the World Penn Table. Source: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006. This institution kindly provided the 'no PPP adjusted' version of this variable, which I use here.

Investment/GDP: Taken from the variable 'KI' of the World Penn Table. Source: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006. This institution kindly provided the 'no PPP adjusted' version of this variable, which I use here.

Public education expenditure/GDP: Source: World Bank, World Development Indicators (WDI) April 2008, ESDS International, (Mimas) University of Manchester.

Degree of democracy: Measures the degree of institutionalised democracy from 0 to 1 (where higher numbers mean more democracy). This variable is a linear transformation of the variable 'Polity' from the Polity IV database, which ranges from -10 to 10. Source: Monty G. Marshall and

Keith Jagers. 2004. Polity IV Data Set. [Computer file; version p4v2004] College Park, MD: Center for International Development and Conflict Management, University of Maryland.

Average years of Schooling for the population aged 15 years and over:

Source: Robert J. Barro and Jong-Wha Lee (2000), 'International Data on Educational Attainment: Updates and Implications', Center for International Development at Harvard University, working paper No 42. Taken from EdStats Database, World Bank. The growth of this variable (table 3) is expressed in percentage points, calculated as

$$100 * \left(\frac{Value_t - Value_{t-1}}{Value_{t-1}} \right).$$

Trade/GDP: Sum of exports and imports of goods and services measured as a share of gross domestic product. Source: World Bank, World Development Indicators (WDI) April 2008, ESDS International, (Mimas) University of Manchester.

Annual inflation rate: Source: World Bank, World Development Indicators (WDI) April 2008, ESDS International, (Mimas) University of Manchester.

Population 15-64 years/Total population: Percentage of the total population that is in the age group 15 to 64. Source: World Bank, World Development Indicators (WDI) April 2008, ESDS International, (Mimas) University of Manchester.

Appendix 2: Countries used in tables 2 and 3

Countries included in regressions of table 2:				Countries included in regressions of table 3			
Group 1: All countries		Group 2: "No Rich" subset		Group 3: All countries		Group 4: "No Rich" subset	
Albania	Lao PDR	Albania	Nepal	Algeria	Kuwait	Alghanistan	Sao Tome & Principe
Algeria	Latvia	Algeria	Nicaragua	Argentina	Lesotho	Albania	Senegal
Argentina	Lesotho	Argentina	Niger	Australia	Liberia	Argentina	Seychelles
Armenia	Madagascar	Armenia	Nigeria	Austria	Malawi	Azerbaijan	Slovak Republic
Australia	Malawi	Azerbaijan	Oman	Bahrain	Malaysia	Bangladesh	Solomon Islands
Austria	Malaysia	Bangladesh	Pakistan	Bangladesh	Mali	Belarus	Somalia
Azerbaijan	Mali	Belarus	Panama	Belgium	Mauritius	Bhutan	South Africa
Bahrain	Mauritania	Bhutan	Paraguay	Benin	Mexico	Botswana	Sri Lanka
Bangladesh	Mauritius	Bolivia	Peru	Bolivia	Mozambique	Burkina Faso	Sudan
Belarus	Mexico	Botswana	Philippines	Botswana	Nepal	Burundi	Tanzania
Belgium	Moldova	Bulgaria	Poland	Brazil	Netherlands	Cambodia	Tonga
Bhutan	Mongolia	Burkina Faso	Romania	Bulgaria	New Zealand	Cameroon	Turkey
Bolivia	Morocco	Burundi	Rwanda	Cameroon	Nicaragua	Chad	Ukraine
Botswana	Mozambique	Cameroon	Senegal	Canada	Niger	Chile	Uzbekistan
Bulgaria	Namibia	Central African Rep	Sierra Leone	Central African Rep	Norway	Colombia	Yemen. Rep.
Burkina Faso	Nepal	Chad	Solomon Islands	Chile	Pakistan	Comoros	Zambia
Burundi	Netherlands	Chile	South Africa	China	Panama	Congo. Rep.	
Cameroon	New Zealand	China	Sri Lanka	Colombia	Papua New Guinea	Cuba	
Canada	Nicaragua	Colombia	Sudan	Congo. Dem. Rep.	Paraguay	Djibouti	
Central African Rep	Niger	Congo. Rep.	Swaziland	Congo. Rep.	Peru	Dominican Rep.	
Chad	Nigeria	Costa Rica	Syrian Arab Rep	Costa Rica	Philippines	Ecuador	
Chile	Norway	Dominican Republic	Tanzania	Croatia	Poland	El Salvador	
China	Oman	Ecuador	Thailand	Cyprus	Portugal	Entrea	
Colombia	Pakistan	Egypt. Arab Rep.	Togo	Czech Republic	Romania	Ethiopia	
Congo. Rep.	Panama	El Salvador	Tunisia	Denmark	Rwanda	Fiji	
Costa Rica	Paraguay	Ethiopia	Turkey	Dominican Rep	Senegal	Gabon	
Cyprus	Peru	Fiji	Uganda	Ecuador	Sierra Leone	Gambia. The	
Denmark	Philippines	Gabon	Ukraine	Egypt. Arab Rep.	Singapore	Georgia	
Dominican Republic	Poland	Gambia. The	Uruguay	El Salvador	Slovak Republic	Ghana	
Ecuador	Portugal	Ghana	Venezuela. RB	Fiji	Slovenia	Guatemala	
Egypt. Arab Rep.	Romania	Guatemala	Zambia	Finland	South Africa	Guinea	
El Salvador	Rwanda	Haiti	Zimbabwe	France	Spain	Guyana	
Ethiopia	Saudi Arabia	Honduras		Gambia. The	Sri Lanka	Iraq	
Fiji	Senegal	Hungary		Germany	Sudan	Jordan	
Finland	Sierra Leone	India		Ghana	Swaziland	Kazakhstan	
France	Solomon Islands	Indonesia		Greece	Sweden	Kenya	
Gabon	South Africa	Iran. Islamic Rep.		Guatemala	Switzerland	Kiribati	
Gambia. The	Spain	Ireland		Guinea-Bissau	Syrian Arab Rep	Liberia	
Ghana	Sri Lanka	Jamaica		Haiti	Tanzania	Libya	
Greece	Sudan	Jordan		Honduras	Thailand	Lithuania	
Guatemala	Swaziland	Kazakhstan		Hungary	Togo	Malawi	
Haiti	Sweden	Kenya		India	Trinidad & Tobago	Malaysia	
Honduras	Switzerland	Kyrgyz Republic		Indonesia	Tunisia	Maldives	
Hungary	Syrian Arab Rep	Lao PDR		Iran. Islamic Rep	Turkey	Mauritania	
India	Tanzania	Latvia		Ireland	Uganda	Mauritius	
Indonesia	Thailand	Lesotho		Israel	United Kingdom	Mexico	
Iran. Islamic Rep.	Togo	Madagascar		Italy	United States	Moldova	
Ireland	Trinidad & Tobago	Malawi		Jamaica	Uruguay	Mongolia	
Israel	Tunisia	Malaysia		Japan	Venezuela. RB	Mozambique	
Italy	Turkey	Mali		Jordan	Zambia	Nicaragua	
Jamaica	Uganda	Mauritania		Kenya	Zimbabwe	Niger	
Japan	Ukraine	Mauritius		Korea. Rep.		Nigeria	
Jordan	United Kingdom	Mexico				Palau	
Kazakhstan	United States	Moldova				Panama	
Kenya	Uruguay	Mongolia				Papua New Guinea	
Korea. Rep.	Venezuela. RB	Morocco				Paraguay	
Kuwait	Zambia	Mozambique				Poland	
Kyrgyz Republic	Zimbabwe	Namibia				Romania	

Appendix 3: Descriptive statistics for expenditure regressions

Variable		Mean	Std. Dev.	Coefficient of variation	Min	Max	Observations
ln of GDP per capita growth	overall	0.0302	0.1076	3.565	-0.60282	0.29828	<i>N</i> = 788
	between		0.0593	1.965	-0.12617	0.24787	<i>n</i> = 116
	within		0.0905	2.998	-0.58291	0.41106	<i>N/n</i> = 6.79
ln GDP per capita	overall	7.4323	1.5804	0.213	4.63667	10.55055	<i>N</i> = 905
	between		1.5675	0.211	4.79938	10.36176	<i>n</i> = 116
	within		0.1723	0.023	6.54618	8.28129	<i>N/n</i> = 7.80
Democracy	overall	0.5984	0.3628	0.606	0	1	<i>N</i> = 901
	between		0.3121	0.522	0	1	<i>n</i> = 116
	within		0.1838	0.307	-0.09784	1.19216	<i>N/n</i> = 7.77
Public education expenditure/GDP	overall	4.4525	2.4986	0.561	0.4	41.8	<i>N</i> = 802
	between		2.2492	0.505	1.24286	21.22	<i>n</i> = 116
	within		1.3871	0.312	-9.96751	25.03249	<i>N/n</i> = 6.91
Trade	overall	69.0415	36.0625	0.522	11.34016	238.7488	<i>N</i> = 892
	between		33.4609	0.485	19.28616	176.5348	<i>n</i> = 116
	within		13.0174	0.189	17.22289	131.2556	<i>N/n</i> = 7.69
Inflation	overall	45.6417	309.7403	6.786	-3.80549	5244.197	<i>N</i> = 840
	between		172.4902	3.779	-0.30565	1329.887	<i>n</i> = 116
	within		275.8129	6.043	-1281.402	3959.952	<i>N/n</i> = 7.24
Public expenditure/GDP	overall	16.3096	6.8437	0.420	2.4	47.7	<i>N</i> = 900
	between		6.1141	0.375	3.7625	33.9125	<i>n</i> = 116
	within		3.0358	0.186	0.79706	34.10955	<i>N/n</i> = 7.76
Investment/GDP	overall	21.9537	8.6419	0.394	3.8	65.6	<i>N</i> = 900
	between		7.0241	0.320	5.6625	46.9	<i>n</i> = 116
	within		5.1372	0.234	4.21617	55.81616	<i>N/n</i> = 7.76
Population 15-64 /Total population	overall	58.6656	6.5001	0.111	47	73	<i>N</i> = 927
	between		6.2235	0.106	48.25	68.625	<i>n</i> = 116
	within		1.9552	0.033	51.9513	67.04059	<i>N/n</i> = 7.99

Variables described in appendix 1. *N* stands for total number of observations, and *n* for number of countries. 'Between' observations consist of the average across time for each country (\bar{x}_i), so there are *n* 'between' observations (one per country). 'Within' observations consist of the deviations from each individual's average. Stata adds the overall mean to this deviation: $x_{it} - \bar{x}_i + \bar{x}$, where \bar{x} refers to overall mean. The coefficient of variation is computed as the relevant standard deviation over the overall mean.

Appendix 4: Descriptive statistics for regressions using average years of schooling

Variable		Mean	Std. Dev.	Coefficient of variation	Min	Max	Observations
ln of GDP per capita growth	overall	0.0810	0.1436	1.772	-1.43684	0.65369	<i>N</i> = 747
	between		0.0920	1.136	-0.24042	0.34550	<i>n</i> = 103
	within		0.1101	1.359	-1.17669	0.71017	<i>N/n</i> = 7.25
ln GDP per capita	overall	7.5054	1.5831	0.211	4.43426	10.92408	<i>N</i> = 851
	between		1.5459	0.206	4.91441	10.23103	<i>n</i> = 103
	within		0.3253	0.043	5.99387	8.97048	<i>N/n</i> = 8.26
Democracy	overall	0.5859	0.3674	0.627	0	1	<i>N</i> = 876
	between		0.3077	0.525	0.0385714	1	<i>n</i> = 103
	within		0.2053	0.350	-0.03963	1.16926	<i>N/n</i> = 8.50
Growth in average years of schooling of individuals of 15 years and more	overall	11.9044	17.3775	1.460	-16.7033	190.1786	<i>N</i> = 773
	between		9.6507	0.811	-3.000276	50.7688	<i>n</i> = 103
	within		14.6269	1.229	-28.22195	174.09360	<i>N/n</i> = 7.50
Trade	overall	62.1078	36.0029	0.580	7.210826	393.0149	<i>N</i> = 830
	between		45.6972	0.736	15.78977	393.0149	<i>n</i> = 103
	within		15.2954	0.246	5.34751	152.15810	<i>N/n</i> = 8.06
Inflation	overall	36.0904	265.3176	7.351	-3.009998	6424.988	<i>N</i> = 784
	between		102.2978	2.834	2.301196	796.6487	<i>n</i> = 103
	within		244.0583	6.762	-745.6145	5664.43	<i>N/n</i> = 7.61
Investment/GDP	overall	22.5524	9.8154	0.435	4.13000	101.16	<i>N</i> = 870
	between		7.0050	0.311	5.73286	44.03111	<i>n</i> = 103
	within		6.8289	0.303	-10.97319	82.31682	<i>N/n</i> = 8.45
Population 15-64 /Total population	overall	57.9692	6.5525	0.113	47.06	73.22	<i>N</i> = 927
	between		5.8306	0.101	48.96444	68.08667	<i>n</i> = 103
	within		3.0385	0.052	45.87034	69.15368	<i>N/n</i> = 9.00

Variables described in appendix 1. *N* stands for total number of observations, and *n* for number of countries. 'Between' observations consist of the average across time for each country (\bar{x}_i), so there are *n* 'between' observations (one per country). 'Within' observations consist of the deviations from each individual's average. Stata adds the overall mean to this deviation: $x_{it} - \bar{x}_i + \bar{x}$, where \bar{x} refers to overall mean. The coefficient of variation is computed as the relevant standard deviation over the overall mean.

Chapter 5

Summary and conclusions

It has been argued that the benefits of education go beyond the increase in personal or macroeconomic income. Re-quoting Weiss (1995), “*education does not have to be justified solely on the basis of its effect on labour productivity. This was certainly not the argument given by Plato or de Tocqueville and need not be ours. Students are not taught civics, or art, or music solely in order to improve their labour productivity but rather to enrich their lives and make them better citizens*” (Weiss 1995, p. 151).

But is this true? Does education enrich our lives? Does it make us better citizens? Measuring the degree of ‘richness of life’ or ‘good citizenship’ are difficult tasks that require different kinds of abilities, so I left those aside. Instead, I focused on what I expected would be the easiest assessment of all: the effect of education on income. To my surprise, I learnt that this is not an easy task either and that several scholars have been debating it for years.

If the effect of education on aggregate income is not clearly visible, why have almost all countries devoted great amounts of public resources to education for as long as data are available? What is guiding policy? And why have different countries devoted different proportions of their resources to public education?

I have not come up with a complete explanation as to why governments allocate money to public education. However, I have added a novel factor to explain at least part of the divergence in international public education expenditure: according to chapter 2, altruism tends to act as a deterrent for public subsidies to education. We should expect less altruistic countries to publicly subsidise education more than more altruistic countries, probably because (the following statement is not proved here and is offered as a hypothesis) the state has to compensate for the lack of educational care that non-altruistic parents will devote to their children. Chapter 2 also shows that more forward-looking countries can be expected to subsidise education relatively more than less forward-looking countries.

However, it is on the topic of altruism that chapter 2 adds more to the current knowledge, for at least two reasons. First, altruism has not been presented before as a possible source of divergence in public subsidies to education. The chapter presents theoretical and empirical evidence that altruism may be a relevant factor. Second, the exploration of cross-country data using a proxy for the level of altruism is novel in the literature to the best of my knowledge. More should be done to obtain better measures of altruism, although I am confident that the proxy presented in chapter 2 is the best available reliable proxy, and should be at least considered in the future by researchers who want to understand how governments make their decisions of education subsidisation.

I do not know what shapes the degree of altruism of a society. At this stage, I would assume that the degree of altruism is an idiosyncratic fixed characteristic of a society. This means that it could be taken as an exogenous factor constraining the policy decisions (in this case, the decisions on public expenditure on education).

Therefore, the decision of how much to devote to education cannot be understood only by considering the effect of education on economic growth. Other factors have an influence and impose constraints too. Whereas chapter 2 investigates the constraints imposed by altruism, chapter 3 incorporates the constraints on public education expenditure faced by an agent that intuitively could be assumed to have no constraints at all: a dictator. Although a dictator does not necessarily maximise a social utility function and may only be guided by his own interests, chapter 3 shows that this does not mean that he faces no constraints when deciding how much to spend on public education and how much to extract from the economy for his own benefit. The model presented in that chapter identifies some trade-offs and shows how the effect of education expenditure on income growth interfere with the dictator's decision of how much to extract from the economy for his own benefit, imposing constraints on his decision making process.

The analysis of the transitions between democracy and dictatorship has not been approached before through looking simultaneously at the effects of education expenditure on income and the pressures from a limited labour market on the extractive capacity of a dictator. That is the single most important contribution of chapter 3. This novel approach allows for the determination of threshold levels of extortive taxes and the analysis of regime transitions. In addition, the model explains why redistributive policies can be expected to be more extended in democracies than in non-democracies (which has been argued by previous researchers), and why some countries need to resort to amnesties to facilitate peaceful transitions to democracy.

One of the key findings of chapter 3 relates to why dictators have an incentive to ‘blur’ the effect of education on income, so that the absence of democracy is related to a lower impact of education on macroeconomic income. This is hypothesised in chapter 1, but only empirically tested in chapter 4. The evidence presented in chapter 4 fails to reject the hypothesis that the effect of education on economic growth is greater in democracies than in non-democracies. This holds in models that map for education through public expenditure on education as a share of GDP and in models that use the average years of schooling of the population. The contribution of chapter 4 to the existing knowledge is to show that the prevailing political regime (the degree of democracy in this case) plays a role in the effect of education on economic growth. In this way, democracy summarises the institutional and governance environment that Pritchett (1996 and 2001) understands is required to avoid ‘piracy’ and to make education an input for economic growth.

This can help set an agenda for policymakers, who should ensure that they set the *right institutions* in place before engaging the public finances in additional educational efforts. Though institutional economics has long claimed this, chapter 4 argues for new indirect effects that have not been addressed previously. Chapter 4 also has implications for future research. This

is the first time that the effect of education on economic growth has been measured using interaction terms between education and the level of democracy. I am confident that this approach can be used in the future to assess the indirect effect of other factors on growth.

In particular, as more data on cognitive skills becomes available and time series can be constructed for a wide set of countries, the analysis of chapter 4 should be reproduced to check whether the results hold in the long run with that new data. In general, the analysis of the last chapter opens the door for analysis of the indirect effect of institutions on growth through factors other than education.

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