To Segregate or to Integrate: Education Politics and Democracy*

David de la Croix† Matthias Doepke‡

July 2008

Abstract

How is the quality of public education affected by the presence of private schools for the rich? Theory and evidence suggest that the link depends crucially on the political system. We develop a theory that integrates private education and fertility decisions with voting on public schooling expenditures. We find that the presence of a large private education sector benefits public schools in a broad-based democracy where politicians are responsive to low-income families, but crowds out public-education spending in a society that is politically dominated by the rich. The main predictions of the theory are consistent with state-level and micro data from the United States as well as cross-country evidence from the PISA study.

JEL Classification Numbers: D72, I21, H42, O10.

*We thank Sandy Black, Georges Casamatta, Jean Hindriks, Omer Moav, Fabien Moizeau, Vincent Vandenberghe, the editor, three anonymous referees, and seminar participants at Louvain-la-Neuve, Rotterdam, the Stockholm School of Economics, Toulouse, UCLA, Royal Holloway, Tel Aviv, and the SED Annual Meeting in Florence for comments that helped to make substantial improvements to the paper. Simeon Alder and David Lagakos provided excellent research assistance. David de la Croix acknowledges financial support from the Belgian French-speaking community (grant ARC 99/04-235) and the Belgian Federal Government (grant PAI P5/21). Matthias Doepke acknowledges support from the National Science Foundation (grant SES-0217051) and the Alfred P. Sloan Foundation.

†Department of Economics and CORE, Université catholique de Louvain, Place Montesquieu 3, B-1348 Louvain-la-Neuve, Belgium (e-mail: david.delacroix@uclouvain.be).

‡Department of Economics, Northwestern University, 2001 Sheridan Blvd, Evanston, IL 60608 (e-mail: doepke@northwestern.edu.)

1 Introduction

Public schooling is one of the most pervasive social policies around the world today. Following the lead of industrializing European nations in the nineteenth century, nearly all countries have introduced compulsory schooling laws and public funding of education. However, despite the almost universal involvement of governments, private and public funding of education continue to coexist. The share of private education funding varies greatly across countries, from only 1.9 percent of total spending in Norway, to 44.5 percent in Chile (1998, see Section 6). Institutional arrangements concerning the funding of private schools also differ across countries. Private schools can be supported partly by the government as in France or New Zealand, can be entirely publicly funded as in Belgium, or may rely exclusively on private funding as in the United States (Toma 1996).

Recently, the OECD Programme for International Student Assessment (PISA), which assesses the knowledge and skills of 15-year-old students in a cross-section of countries, has sparked an intense debate on the relative merits of different education systems. A central question in this debate is why education systems differ so much across countries in the first place. Are there particular country characteristics that explain the choice of an integrated education system over a regime that segregates public from private schools? Equally important are the implications for school quality: How is the funding level of public education affected by the presence of private schools for the rich?

The aim of this study is to provide a positive theory of education systems that can be used to address these questions. We develop an analytically tractable framework that integrates political determination of the quality of public schools with private education and fertility decisions. Parents may choose between sending their children to tax-financed public schools and, alternatively, opting out of the public system and providing private education to their children. They also determine their number of children as a function of their income and of the expected quality of schools. A key feature of our political economy setup is that it allows for bias in the political system: the weight of a certain group of voters in political decision making may be larger or smaller that the group's relative size in the population. In particular, we contrast outcomes under an even distribution of political power, as in a representative democracy, with outcomes when a political bias gives a disproportionate share of power to the rich.

Consider first the case of a true democracy, in which the rich and poor have equal weight in the political process. Parents send their children to a private school only if they would like to endow their children with an education of a much higher quality than that provided by the public system. This implies that income inequality is the main determinant of the extent of segregation in the schooling system. In a society with little inequality, the preferred education level varies little in the population, so that most or all parents use public schooling. For increasing levels of inequality, an increasing share of richer people chooses private education for their children.[1]

From a policy perspective, perhaps the most important question is how the extent of private schooling affects the quality of public schooling. In our political-economy model, when more and more rich parents send their children to private school, these parents no longer stand to gain from high-quality public education. These parents therefore vote for lower taxes and less spending on public schools. It does not necessarily follow, however, that the quality of public schools will decline as the share of private education increases. When rich parents opt out of the public system, the remaining funding of the public system can be concentrated on fewer students. Thus, even when there is a decline in total funding, spending per student (which is one measure of the quality of education) may well go up.[2] We show that as long as the poor carry equal weight in the political system, the relationship between the share of private schooling and the quality of public schooling is indeed positive.

An additional benefit from private education arises because fertility decisions are endogenous. Consistent with empirical evidence, the theory predicts that poorer parents who use public schools have more children than parents opting for costly private schools. By raising their fertility rate relative to what they would choose if they were paying for their children's education, the public-school parents impose

[1] This echoes the result of Besley and Coate (1991). Assuming that quality is a normal good, households who opt out of the public sector are those with higher incomes.

[2] This result provides a contrast to a literature in which a greater degree of inequality motivates more redistribution through higher taxes (see Alesina and Rodrik 1994, Persson and Tabellini 1994, and in particular Gradstein and Justman 1997 in an application to education).

a fiscal externality on all taxpayers. This externality is absent if parents send their children to private schools and therefore fully take into account the education cost of the marginal child.

The findings described so far apply to countries with equal political representation for all. But what about countries farther away from the democratic ideal? Consider a non-democratic country in which only the political views of an entrenched, rich elite matter. If inequality is not too severe, one possibility is that most families, including the elite, use public schools. In this case, the political elite has a direct interest in the quality of public schools, and the outcomes in terms of education spending and the quality of schooling are similar to those of an otherwise identical democracy. However, a second possibility is that most or all of the political elite use private schools. Public education spending and the quality of public schools then tend to be low, because the political elite has no vested interest in public schooling. Thus, unlike in democracies, a high share of private schooling will generally lead to a low quality of public schools.

The main predictions of our theory are consistent with a set of stylized facts on public and private schooling in the U.S. as well as in a cross section of countries. For the U.S., we document that states with higher inequality have a larger share of private schooling and lower overall spending on public schooling, but a higher quality of public schooling. At the micro level, fertility is decreasing and the probability of using private schools is increasing in income. Moreover, the slope of the income-fertility relationship is flatter in states with a higher quality of public schooling. We obtain similar findings in cross-country data. Using micro data from the OECD PISA program, we confirm that in a large set of countries high-income households are more likely to use private education, while these households' fertility rates are lower. Comparing across countries, high inequality is associated with a larger share of private schooling.

Concerning the role of political power, we turn to the relationship between democracy and education funding. If we interpret democracies as countries with an even distribution of political power, while non-democracies are biased to the rich, our model implies that there is more scope for variation in education systems in non-democracies than in democracies. Indeed, using a cross section of 158 countries, we find that the variance of public spending across countries is smaller for democracies than for non-democracies.

Our paper relates to different branches of the literature. A number of authors have addressed the choice of public versus private schooling within a majority voting framework (see Stiglitz 1974, Glomm and Ravikumar 1998, Epple and Romano 1996b, and Bearse, Glomm, and Patterson 2005). A recurring theme in this literature is the argument that if there are private alternatives to public schools, voters' preferences may not be single-peaked, so that a majority voting equilibrium may fail to exist. In contrast, we rely on probabilistic voting as the political mechanism, which yields a fully tractable theory of education regimes in which voting equilibria are guaranteed to exist. Moreover, our probabilistic voting setup is not restricted to democracies, since we can analyze what happens if the political system is biased to the rich. The second main departure from the existing literature is that we endogenize fertility decisions, which leads to novel implications for uniqueness and efficiency properties of equilibria.

Our model makes predictions for the link between inequality in a country and the resulting education system and quality of education. A similar objective is followed by Fernández and Rogerson (1995), who consider a model where education is discrete and partially subsidized by the government, and voters decide on the extent of the subsidy. Fernández and Rogerson emphasize that in unequal societies, the poor may forgo education entirely. Since all voters are taxed, in this case public education constitutes a transfer of resources from the poor and the rich to the middle class, echoing the findings of Epple and Romano (1996a). While these arguments are highly relevant for the case of post-secondary education, at the primary and secondary levels participation rates are high even for poor children in most countries. Thus, at these levels the choices that we model here (private versus public education and the quality of public education) may be the more important margins.

Another branch of the literature takes the schooling regime (public or private) as given, and analyzes the economic implications of each regime. Glomm and Ravikumar (1992) contrast the effects of public and private schooling systems on growth and inequality. In a country with little inequality, a fiscal externality created by public schooling leads to lower growth under public schooling than under private schooling. In unequal societies, however, public schooling can dominate, since more resources are directed to poor individuals with a high return on education. Similar conclusions are derived by de la Croix and Doepke (2004) in a framework which emphasizes the interdependence of fertility and education decisions of parents. The model of Glomm and Ravikumar (1992) has been extended by Bénabou (1996) to allow for local interactions between agents, such as neighborhood effects and knowledge spillovers. Our work advances relative to these papers by endogenizing the choice of the schooling regime as a function of the income distribution and the political system.

Finally, Bénabou (2000), among others, has pointed out that in the data, more unequal countries tend to redistribute less. Our model provides a rationale for this empirical finding. Bénabou (2000) also develops a model that is consistent with this observation, albeit through a different mechanism. In his setup, it is assumed that political participation increases with income. When inequality rises, the decisive voter is richer and decides for less redistribution. The opting-out decision in our model provides an alternative to Bénabou's mechanism. A crucial difference between the two theories is that in our model, as long as political power is evenly distributed an increase in inequality actually improves the welfare of a poor agent of a given income, even though total tax revenue declines. This is possible because the quality of public schooling improves: the number of students who use public schools declines faster with inequality than overall tax revenue, implying that the funding level per student increases. Thus, even though an increase in inequality reduces the total amount of redistribution, the transfers to public-school parents become more targeted, leaving the poor better off.

In the next section, we introduce our model and analyze the political equilibrium. Section 3 describes how in a democratic country the choice of a schooling regime and the quality of schooling depend on the income distribution. Section 4 generalizes the voting process to allow for unequal political power. We show that multiple equilibria can arise in societies dominated by the rich. In Section 5 we analyze alternative timing assumptions. In Section 6 we confront the testable implications of the model with empirical evidence. Section 7 concludes. All proofs are contained in the mathematical appendix.

2 The Model Economy

2.1 Preferences and technology

The model economy is populated by a continuum of households of measure one. Households are differentiated by their human capital endowment x, where x is the wage that a household can obtain in the labor market. People care about consumption c, their number of children n, and their children's education h. The utility function is given by:[3]

$$\ln(c) + \gamma\left[\ln(n) + \eta\ln(h)\right]. \tag{1}$$

Notice that parents care both about child quantity n and quality h. The parameter $\gamma \in \mathbb{R}_+$ is the overall weight attached to children. The parameter $\eta \in (0, 1)$ is the relative weight of quality.[4] As we will see below, the tradeoff between quantity and quality is affected by the human capital endowment of the parent and by the schooling regime.

To attain human capital, children have to be educated by teachers. The wage of teachers equals the average wage in the population, which is normalized to one.[5] Parents can choose between two different modes of education. First, there is a public schooling system, which provides a uniform education s to every student. Education in the public system is financed through an income tax v; apart from the tax, there are no direct costs to the parents. The schooling quality s and the tax rate v are determined through voting, to be described in more detail later. Parents also have the possibility of opting out of the public system. In this case, parents can freely choose the education quality e, but they have to pay the teacher out of

[3]The logarithmic utility function is chosen for simplicity; any utility function representing homothetic preferences over the bundle (c, n, h) would lead to the same results. Also, while we focus on a static framework here, the working-paper version of this paper extends the analysis to a dynamic setting where today's children are tomorrow's adults.

[4]The parameter η cannot exceed 1 because the parents' optimization problem would not have a solution. More specifically, utility would approach infinity as parents choose arbitrarily high levels of education and arbitrarily low levels of fertility. A similar condition can be found in Moav (2005).

[5]The important assumption here is that the cost of education is fixed, i.e., all parents face the same education cost regardless of their own wage. The level of the teacher's wage is set to the average wage for convenience.

their own income. Since education e is measured in units of time of the average teacher, the total cost of educating n children privately is given by ne. We assume that education spending is tax deductible. While tax deductibility of education expenditures varies across countries, deductibility simplifies the analysis because it implies that taxation does not distort the choice between quantity and quality of children.[6] Apart from the education expenditure, raising one child also takes fraction $\phi \in (0,1)$ of an adult's time. The budget constraint for an adult with wage x is given by:

$$c = (1-v)\left[x(1-\phi n) - ne\right]. \tag{2}$$

Education is thus either private, e, or public, s. Effective education can be expressed as the maximum of the two: $h = \max\{e,s\}$. Of course, parents who prefer public education will choose $e = 0$.

Substituting the budget constraint (2) into the utility function (1) allows rewriting the utility of a given household as:

$$u[x,v,n,e,s] = \ln(1-v) + \ln(x(1-\phi n) - ne) + \gamma \ln n + \gamma\eta \ln \max\{e,s\}.$$

The consumption good is produced by competitive firms using labor as the only input. We assume that the aggregate production function is linear in effective labor units. The production setup does not play an important role in our analysis; the advantage of the linear production function is that the wage is fixed.

2.2 Timing of events and private choices

The level of public funding for education s is chosen by a vote among the adult population. The voters' preferences depend on their optimal fertility and education choices (n and e), which are made before voting takes place. In making these choices, agents have perfect foresight regarding the outcome of the voting process. This timing is motivated by the observation that public education spending can be adjusted frequently, while fertility cannot. Similarly, the choice

[6]The same result would arise if parents educated their own children (or at least had the option to do so), because then the parents' teaching efforts would reduce their taxable income.

between public versus private education entails substantial switching costs, especially when educational segregation is linked to residential segregation.[7]

At given expected policy variables v and s, the utility function u is concave in n. Within each group, some agents may choose public schooling, in which case their fertility rate is denoted n^s, while others opt for private education; fertility for those in private schools is denoted as n^e. All parents planning to send their children to the public school choose the same fertility level:

$$n^s = \arg\max_n u[x, v, n, 0, s] = \frac{\gamma}{\phi(1+\gamma)}. \tag{3}$$

Fertility is constant because the income and substitution effects exactly offset each other. On the one hand, richer parents would like to have more children, but on the other hand their opportunity cost of raising children is also higher.

The households planning to provide private schooling chose:

$$\begin{aligned} n &= \arg\max_n u[x, v, n, e, s] = \frac{x\gamma}{(1+\gamma)(e+\phi x)}, \\ e[x] &= \arg\max_e u[x, v, n, e, s] = \frac{\eta\phi x}{1-\eta}. \end{aligned} \tag{4}$$

Private spending on education depends positively on the wage x. Since the basic cost of children is a time cost, having children is expensive for skilled parents. In contrast, the cost of educating children is a resource cost, which is more affordable for skilled, high-income parents. Hence, they have a comparative advantage in terms of raising educated children (as in Moav (2005)).

Notice that e is independent of the outcome of the voting process, implying that the timing of choosing e does not affect the results (in contrast, we will see in Section 5 that the timing of choosing between public and private schooling does matter). Replacing the optimal value for $e[x]$ in the fertility equation we find:

$$n^e = \frac{\gamma(1-\eta)}{\phi(1+\gamma)}. \tag{5}$$

Thus, conditional on choosing private schooling, fertility is independent of x as

[7] In Section 5 we will explore the implications of alternative timing assumptions.

well. From equations (3) and (5) we see that parents choosing private education have a lower fertility rate.

Lemma 1 (Constant parental spending on children)
For given s, v and x, parental spending on children (and therefore taxable income) does not depend on the choice of private versus public schooling, and is equal to $\frac{\gamma}{1+\gamma}\,x$.

Lemma 1 implies that the tax base does not depend on the fraction of people participating in public schooling. This property will be important for establishing uniqueness of equilibrium. The lemma relies on three assumptions: homothetic preferences, tax deductible education spending, and endogenous fertility. With endogenous fertility, parents choosing private schools have fewer children, keeping their total budget allocation to children in line with those choosing public schools.[8] This is a typical feature of endogenous fertility models.

A first result is that parents with high human capital are more demanding in terms of expected public education quality. In other words, child quality is a normal good:

Lemma 2 (Opting out decision)
There exists an income threshold:

$$\tilde{x} = \frac{1-\eta}{\delta\phi\eta}\,E[s] \qquad \text{with: } \delta = (1-\eta)^{\frac{1}{\eta}} \tag{6}$$

such that households strictly prefer private education if and only if $x > \tilde{x}$.

Here E$[s]$ is expected quality of public schooling. An implication of the above lemma is that if some people with income x choose public schooling, all people with income $x' < x$ will strictly prefer public schooling. Similarly, if at least some people with income x opt out of the public system and choose private education, all households with income $x' > x$ make the same choice.

We assume a uniform distribution of human capital over the interval $[1-\sigma, 1+\sigma]$. Accordingly, the associated density function is given by $g(x) = 0$ for $x < 1-\sigma$

[8] With fixed fertility, the resources allocated to children would be $x\phi n$ with public education and $x\phi n/(1-\eta)$ with private education. However, even with fixed fertility a constant tax base could be achieved through an endogenous labor supply setup.

and if $x > 1+\sigma$, and $g(x) = 1/(2\sigma)$ for $1-\sigma \leq x \leq 1+\sigma$.[9] We denote the fraction of children participating in the public education system as:

$$\Psi = \begin{cases} 0 & \text{if} \quad \tilde{x} < 1-\sigma, \\ \dfrac{\tilde{x}-(1-\sigma)}{2\sigma} & \text{if} \quad 1-\sigma \leq \tilde{x} \leq 1+\sigma, \\ 1 & \text{if} \quad \tilde{x} > 1+\sigma. \end{cases} \tag{7}$$

2.3 The political mechanism

The public education system operates under a balanced-budget rule:

$$\int_0^{\tilde{x}} n^s \; s \; g[x] \; dx = \int_0^{\tilde{x}} v \left(x(1-\phi n^s) \right) \; g[x] \; dx + \int_{\tilde{x}}^{\infty} v \left(x(1-\phi n^e) - e[x] n^e \right) \; g[x] \; dx, \tag{8}$$

with total spending on public education on the left-hand side and total revenues on the right-hand side. After replacing fertility and education by their optimal values, this constraint reduces to:

$$v = \Psi \frac{\gamma}{\phi} \, s. \tag{9}$$

Since the level of schooling and taxes are linked through the budget constraint, the policy choice is one-dimensional.

The level of public expenditures, and hence taxes, is chosen through probabilistic voting. Assume that there are two political parties, p and q. Each one proposes a policy s^p and s^q. The utility gain (or loss) of a voter with income x if party q wins the election instead of p is $u[x, v^q, n, e, s^q] - u[x, v^p, n, e, s^p]$. Instead of assuming that an adult votes for party q with probability one every time this difference is positive (as in the median voter model), probabilistic voting theory supposes

[9] The uniform distribution of human capital is chosen for simplicity; other distributions would lead to similar results. In particular, in the probabilistic voting model described below (unlike the standard majority voting model) there is no special significance to the relative positions of median and mean income.

that this vote is uncertain. More precisely, the probability that a person votes for party q is given by

$$F\left(u[x, v^q, n, e, s^q] - u[x, v^p, n, e, s^p]\right),$$

where F is an increasing and differentiable cumulative distribution function. This function captures the idea that voters care about an "ideology" variable in addition to the specific policy measure at hand, i.e., the quality of public schooling. The presence of a concern for ideology, which is independent of the policy measure, makes the political choice less predictable (see Persson and Tabellini 2000 for different formalizations of this approach). The probability that a given voter will vote for party q increases gradually as the party's platform becomes more attractive. Under standard majority voting, in contrast, the probability of getting the vote jumps discretely from zero to one once party q offers a more attractive platform than party p.

Since the vote share of each party varies continuously with the proposed policy platform, probabilistic voting leads to smooth aggregation of all voters' preferences, instead of depending solely on the preferences of the median voter. Party q maximizes its expected vote share, which is given by $\int_0^\infty g[x]F(\cdot)dx$. Party p acts symmetrically, and, in equilibrium, we have $s = s^q = s^p$. The maximization program of each party implements the maximum of the following weighted social welfare function:[10]

$$\int_0^\infty g[x]\ (F)'(0)\ u[x, v, n, e, s]dx.$$

The weight $(F)'(0)$ captures the responsiveness of voters to the change in utility. If there are groups in the population that differ in their responsiveness (their "ideological bias"), the distribution of political power becomes uneven. In particular, a group that has little ideological bias cares relatively more about economic policy. Such groups are therefore targeted by politicians and enjoy high political power. In addition, political power may also depend on other features of the political system, such as voting rights. We will capture the political power of each

[10]This result was first derived by Coughlin and Nitzan (1981). The same framework can also be derived within the setup of lobbying models, see Bernheim and Whinston (1986).

person by a single parameter $\theta[x]$. This includes the extreme cases of representative democracy with equal responsiveness, and dictatorship of the rich ($\theta[x] = 0$ for x below a certain threshold). Accordingly, the objective function maximized by the probabilistic voting mechanism is given by:

$$\Omega[s] \equiv \int_0^{\tilde{x}} u[x, v, n^s, 0, s]\theta[x]g[x]dx + \int_{\tilde{x}}^{\infty} u[x, v, n^e, e[x], 0]\theta[x]g[x]dx. \tag{10}$$

The maximization is subject to the government budget constraint (8).

We start by assuming that all individuals have the same political power, i.e. $\theta[x] = 1$, implying that the weight of a given group in the objective function is given simply by its size. The role of this assumption will be investigated further in Section 4. It can be checked that $\Omega[s]$ is strictly concave. Replacing $\tilde{x}$ by $2\sigma\Psi + 1 - \sigma$ in the objective, taking the first-order condition for a maximum, and solving for s yields:

$$s = \frac{\eta\phi}{1 + \gamma\eta\Psi} \equiv s[\Psi]. \tag{11}$$

From this expression we can see that s is decreasing in the participation rate Ψ: when more children participate in public schools, spending per child is reduced. Looking at the corresponding tax rate,

$$v = \frac{\eta\gamma\Psi}{1 + \gamma\eta\Psi}, \tag{12}$$

we observe that a rise in participation is followed by a less than proportional rise in taxation. Since, by Lemma 1, the taxable income is unaffected by increased participation, this translates into lower spending per child. To see the intuition for this result, consider the consequences of increasing Ψ for a given s. In the welfare function maximized by the political system, the increase in Ψ leads to a proportional increase in the marginal benefit of increasing schooling s, since more children benefit from public education. The marginal cost of taxation, in contrast, increases more than proportionally, since the higher required taxes reduce consumption and increase marginal utilities. To equate marginal costs and benefits, an increase in Ψ is therefore met by a reduction in s.

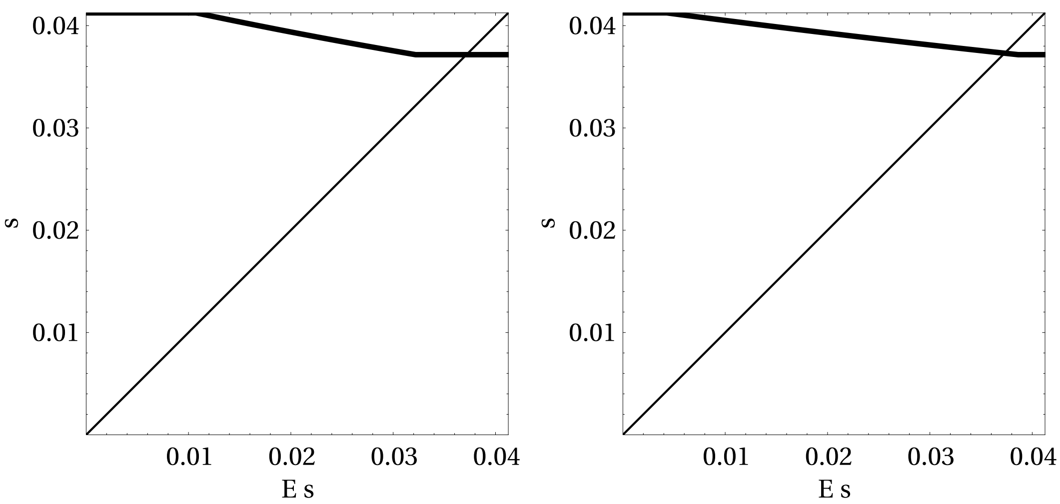


Figure 1: The fixed point with $\sigma = 0.5$ (left) and $\sigma = 0.8$ (right)

2.4 The equilibrium

So far, we have taken the participation rate Ψ as given, and solved for the corresponding voting outcome concerning the quality of public schools. In equilibrium, the choice of whether or not to participate in public schooling has to be optimal. In the definition of equilibrium we will use an earlier result: the incentive to use private schooling is increasing in income (Lemma 2). As a consequence, any equilibrium is characterized by an income threshold $\tilde{x}$ such that people choose public education below $\tilde{x}$ and private education above $\tilde{x}$. This leads to the following definition of an equilibrium:

Definition 1 (Equilibrium)
An equilibrium consists of an income threshold $\tilde{x}$ satisfying (6), a fertility rule $n = n^s$ for $x \leq \tilde{x}$ and $n = n^e$ for $x > \tilde{x}$, a private education decision $e = 0$ for $x \leq \tilde{x}$ and $e = e[x]$ for $x > \tilde{x}$, and aggregate variables (Ψ, s, v) given by equations (7), (11) and (12), such that the perfect foresight condition holds:

$$E[s] = s. \tag{13}$$

Proposition 1 (Existence and Uniqueness of Equilibrium)
An equilibrium exists and is unique.

To see the intuition for the result, notice that participation in public schooling is a continuously increasing function of expected school quality through equations (6) and (7). Actual school quality, in turn, is a continuous and decreasing function of participation. Combining these results, we can construct a continuous and decreasing mapping from expected to actual school quality. This mapping has a unique fixed point, which characterizes the equilibrium.

The uniqueness result relies on endogenous fertility. If one assumes, to the contrary, that fertility is exogenous and constant, Lemma 1 no longer holds, and the tax basis increases with participation Ψ. If the tax-basis effect is sufficiently pronounced, the actual schooling level will no longer decrease in participation, and the equilibrium mapping may fail to have a unique fixed point.

Figure 1 shows two numerical examples of the fixed point mapping. The chosen parameters are: $\gamma = 0.4$, $\eta = 0.55$, $\phi = 0.075$. The implied fertility levels are $n^e = 1$, $n^s = 2.22$. In the left panel, $\sigma = 0.5$, and we have $s = 0.034$ and $\Psi = 1$. In the right panel, $\sigma = 0.8$, and we have $s = 0.037$ and $\Psi = 0.96$.

3 Comparing the Education Regimes

Depending on the coverage of the public education system, we have three cases to consider.

Regime	Ψ
Fully Public	1
Segregation	$\in (0,1)$
Fully Private	0

In the fully public regime, all children go to public school. Under segregation, the most skilled parents send their children to private school, while others use public schools. In the fully private regime, everybody attends private schools. We first derive the conditions under which each education regime arises. The following proposition summarizes the results.

Proposition 2 (Occurrence of education regimes)
The fully private regime is not an equilibrium outcome.
Whether public schooling can arise in equilibrium depends on the preference parameters γ *and* η*. Let* $\hat{\gamma} = (1 - \delta - \eta)/(\delta\eta)$*.*
If $\gamma > \hat{\gamma}$*, public education is not an equilibrium outcome and* $\Psi < 1/2$ *for any* σ*.*
If $\gamma < \hat{\gamma}$*, the fully public regime prevails if and only if*

$$\sigma \leq \hat{\sigma} = \frac{1-\eta}{(1+\gamma\eta)\delta} - 1.$$

Otherwise, we have segregation with $\Psi > 1/2$*.*

Let us first explain why the fully private regime cannot be an equilibrium outcome. When participation is very low ($\Psi \rightarrow 0$), high quality public education can be provided at very low tax levels. The quality of public schools is then sufficiently high ($s \rightarrow \eta\phi$) for the poorest parents to prefer public over private education.

To see whether a fully public regime can arise, we have to look at the preferences of the richest person. If this person has a high income relative to the average (high σ), her preferred education quality is sufficiently large relative to what is provided by public schools for private education to be optimal. The effect of inequality on segregation is established in the next proposition. The fully public regime arises only if the income distribution is sufficiently compressed, so that the preferred education level varies little in the population. From now on we restrict attention to the region of the parameter space where the fully public regime can occur for a sufficiently compressed income distribution, and where at any time at least half the population is in public schools.

Assumption 1 *The model parameters satisfy:*

$$\gamma < \hat{\gamma} \equiv \frac{1-\delta-\eta}{\delta\eta}.$$

Since in nearly all countries participation in public schools far exceeds 50 percent, this is the empirically relevant case.[11]

Proposition 3 (Inequality and segregation) *Under Assumption 1, an increase in inequality leads to a lower share of public schooling, a higher quality of public schooling, and lower taxes:*

$$\frac{\partial \Psi}{\partial \sigma} \leq 0, \; \frac{\partial s}{\partial \sigma} \geq 0, \; \frac{\partial v}{\partial \sigma} \leq 0.$$

The inequalities are strict if a positive fraction of parents already uses private schools.

Higher income inequality leads to lower participation in public schools and to more segregation (Ψ closer to $1/2$) if the majority of the population is in public schools. Intuitively, in this case an increase in inequality raises the income of the marginal person (who was indifferent between private and public schooling before the increase in inequality). As a consequence, the preferred level of education increases, and this person now strictly prefers private schooling. The lower participation in public schooling after an increase in inequality also implies that the tax rate goes down. Thus, despite the increased demand for redistribution, everybody is taxed less as more parents opt out of the public schooling system.

The preferences of households at the income threshold $\tilde{x}$ are linked to the relative quality of public versus private schooling. At the threshold, households are indifferent between both types of schools. This implies that the quality they receive from public schools is lower than the quality of private schools, since the gap between the two has to compensate for higher costs of private education. This result is consistent with the literature devoted to the estimation of the relative quality of private education, correcting for the effect of higher social class of the pupils in the private sector. Most of the results suggest that controlling for sample selectivity reduces the achievement advantage of private school students over public school students, but does not eliminate it.[12]

[11] Put differently, using the calibrated parameter values $\eta = 0.6$ and $\phi = 0.075$ from de la Croix and Doepke (2003), Assumption 1 can be read as a condition on fertility n^s (see Equation (3)). The condition imposes $n^s < 7.79$ per person, which requires fertility per woman to be smaller than 15.6 children.

[12] See Kingdon (1996) for India, Bedi and Garg (2000) for Indonesia, Alderman, Orazem, and Paterno (2001) for Pakistan, and Neal (1997) for Catholic U.S. schools. Some other studies find no difference between private and public schools performances (see Goldhaber (1996)).

Notice that if Assumption 1 is satisfied, the unique equilibrium in a economy without inequality ($\sigma = 0$) is fully public schooling. The result may seem surprising at first sight, because public schooling implies a fiscal externality. In an equitable society, the social optimum would be pure private schooling. The reason why public schooling arises nevertheless is linked to our timing assumptions. If parents commit to a schooling choice before the schooling quality is set, a hold-up problem arises. From an ex ante perspective, it would be socially optimal for everybody to commit to using private schools. Ex post, however, if some parents decide to go for public schools anyway, the political system will provide a quality of public schooling that makes this decision optimal after the fact. Thus, the expectation that a certain public service will be provided creates a constituency that ensures that the service will be provided in reality.

4 Political Power and Multiple Equilibria

In this section, we relax the earlier assumption that each member of the population carries equal weight in the voting process. We will see that if political power is concentrated among high-income individuals, multiple equilibria can arise.

As a particularly simple form of variable political power, we consider outcomes with a minimum-income restriction for voting. There is now a threshold $\bar{x}$ such that only individuals with income $x \geq \bar{x}$ are allowed to vote.[13] All individuals above the threshold continue to carry equal weight in the voting process. This formulation captures property restrictions on voting, which were common in the early phases of many democracies. Similar cases of political exclusion can also arise from literacy requirements, age restrictions on voting (given that young people tend to be relatively poor), citizenship restrictions (assuming that recent immigrants are poorer on average than the native population), and political mechanisms other than voting (such as lobbying and bribery) that favor the rich in both democracies and non-democracies.

[13]Similar results would obtain if individuals below the threshold had positive, but sufficiently low weight in the political mechanism.

The objective function of the political system is now given by:

$$\Omega[s] \equiv \int_{\bar{x}}^{\max\{\bar{x},\tilde{x}\}} u[x,v,n^s,0,s]g[x]dx + \int_{\max\{\bar{x},\tilde{x}\}}^{\infty} u[x,v,n^e,e[x],0]g[x]dx. \quad (14)$$

Replacing $\tilde{x}$ by $2\sigma\Psi + 1 - \sigma$ in the objective, taking the first-order condition for a maximum, and solving for s yields:

$$\text{If } \Psi \geq \frac{\bar{x}-(1-\sigma)}{2\sigma}, \qquad s = \frac{\eta\phi\left((1-\sigma)-\bar{x}+2\sigma\Psi\right)}{\Psi\left(\gamma\eta\left((1-\sigma)-\bar{x}+2\sigma\Psi\right)+(1+\sigma)-\bar{x}\right)}. \quad (15)$$

$$\text{If } \Psi < \frac{\bar{x}-(1-\sigma)}{2\sigma}, \qquad s = 0.$$

Hence, with a biased political system corner solutions with a schooling quality of zero may arise. The equilibrium schooling quality s satisfies:

$$s = \max\left\{\frac{\eta\phi\left(1-\sigma-\bar{x}+2\sigma\Psi\right)}{\Psi\left(1+\sigma-\bar{x}+\gamma\eta\left(1-\sigma-\bar{x}+2\sigma\Psi\right)\right)}, 0\right\}. \quad (16)$$

The corresponding tax rate is still given by (12). A few properties of (16) are of interest here. First, we have $s = 0$ for $\Psi \leq \bar{x} - (1-\sigma)/2\sigma$. Second, we have:

$$s = \max\left\{\frac{\eta\phi}{\frac{(1+\sigma-\bar{x})\Psi}{(1-\sigma-\bar{x}+2\sigma\Psi)} + \gamma\eta\Psi}, 0\right\} \leq \frac{\eta\phi}{1+\gamma\eta\Psi},$$

where the right-hand side is the schooling level that arises with equal political power as given by (11). Finally, for $\Psi = 1$ we have

$$s = \frac{\eta\phi}{1+\gamma\eta},$$

just as in the case with equal political power. In the new formulation with variable voting power, the existence of an equilibrium can still be proven. However, the equilibrium is no longer necessarily unique. Further, it is no longer true that the fully private regime never exists (as we showed in Proposition 2 for the democratic case of an even distribution of political power). In fact, in the biased

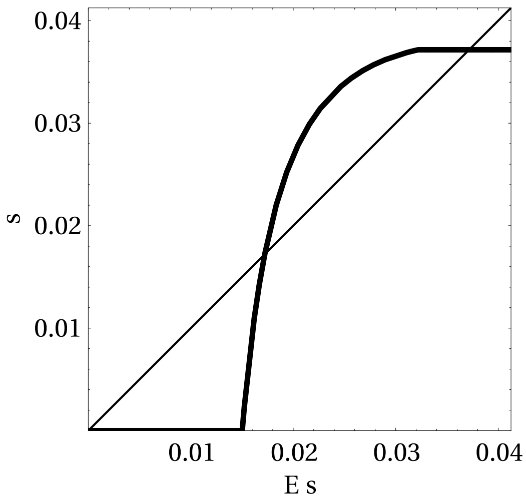


Figure 2: The fixed point with multiple equilibria ($\sigma = 0.5, \bar{x} = 0.7$)

political system, pure private schooling is always an equilibrium outcome.

As soon as $\tilde{x}$ is smaller than $\bar{x}$, i.e., all voters expect to send their children to private schools, the chosen school quality is zero. Intuitively, these voters care only about taxes, and not about the quality of public schools that they do not use. As a consequence, private schooling becomes attractive to all parents.

To show that multiple equilibria can arise, we concentrate on the parameter space where fully public schooling is the unique equilibrium when $\bar{x} = 0$. We establish that in this case there are at least three equilibria for $\bar{x} > 1 - \sigma$.

Proposition 4 (Multiplicity of equilibria for $\bar{x} > 1 - \sigma$)
If $\bar{x}$, γ, and σ satisfy the conditions

$$\bar{x} > 1 - \sigma, \qquad \gamma < \hat{\gamma}, \quad \text{and} \quad \sigma \leq \hat{\sigma} = \frac{1-\eta}{(1+\gamma\eta)\delta} - 1,$$

there are at least three equilibria. One is a fully private regime, one a fully public regime, and one features segregation.

In Figure 2 we take the same parameter values as in Figure 1 and we set $\sigma = 0.5$ and $\bar{x} = 0.7$, which implies that the bottom 20% have no political power. There are now three fixed points: $s = 0$, $s = 0.017$, and $s = 0.037$, with participation $\Psi = 0$, $\Psi = 0.3$, and $\Psi = 1$.

The possibility of multiple equilibria exists because we assume that people have to decide on fertility and public versus private schooling before the vote on the quality of public education takes place. If all decisions were taken simultaneously, the voting process would lead to the same outcome as the weighted social planning problem, which is generically unique. Pre-commitment generates multiplicity in this setting, but not in the version with equal political weights, because there is now a strategic complementarity between the education choices of skilled people through the quality of public schools.[14] When everyone with political power uses private schools, a given individual does not want to switch to the public system, since the quality of the public schooling is low. If, however, all voters were to switch together to the public system, they would vote for a much higher quality of public schools, in which case it would be rational to stay in the public system. Here, the political bias towards the rich offsets the increased cost of taxation resulting from higher participation in public schooling. Provided that there is a strong concentration of political power, the model can account for the fact that some countries with similar general characteristics choose very different educational systems.[15]

The next proposition shows that despite the possibility of multiple equilibria, the coverage of public schooling is never higher in societies dominated by the rich than it is in democracies:

[14] When actions are strategic complements, the utility of those taking the action depends positively on how many people take the action. Classic examples are Matsuyama (1991) for increasing returns, Katz and Shapiro (1985) for network externalities, and Diamond and Dybvig (1983) for bank runs.

[15] A number of authors have derived similar multiplicity results in other applications of voting models. In Saint-Paul and Verdier (1997) there is majority voting on a capital income tax. If political power is unequally distributed, and is biased in favor of households having better access to world capital markets, expectations-driven multiple equilibria can arise. In a dynamic majority voting framework, Hassler, Rodriguez Mora, Storesletten, and Zilibotti (2003) assume that young agents base their education decisions on expectations over future redistribution. Self-fulfilling expectations can lead to either high or low redistribution equilibria. Finally, there are other political economy models that do not have indeterminacy of equilibrium but display multiple steady states (see for example Bénabou 2000 or Doepke and Zilibotti 2005). Initial conditions, as opposed to self-fulfilling expectations, determine which steady state the economy approaches.

Proposition 5 (Coverage of public education as a function of $\bar{x}$)
Let Ψ_0 be the equilibrium coverage of public education for $\hat{x} = x_0$, and v_0 the corresponding tax rate. If Ψ_1 and v_1 are an equilibrium coverage and a tax rate for a $\hat{x} = x_1 > x_0$, then we have

$$\begin{aligned} \Psi_1 &\leq \Psi_0, \\ s_1 &\leq s_0, \\ v_1 &\leq v_0. \end{aligned}$$

In summary, if the rich wield more power than the poor, multiple equilibria may arise. In any such equilibrium, the coverage, quality of, and spending on public education cannot be higher than in the outcome with equal political weights. Fully private education systems are always possible.

While we have established the results of this section for the extreme case where households with an income below $\bar{x}$ do not wield any political power, the results generalize to an environment where these households have some positive weight in the political system, but lower than the weight of households with income above $\bar{x}$. In particular, it is easy to establish that, for any $\bar{x}$, a fully private regime exists if the weight of low-income people is sufficiently small. As before, if in this case the unique equilibrium in the model with an even distribution of political power is pure public schooling, at least three equilibria exist when the poor have less political power.

5 Outcomes with Government Commitment

So far we have assumed that the level of government spending on education is determined after private households have decided whether to send their children to private or public schools. In this section we analyze an alternative timing assumption, namely, the voters elect a government which pre-commits to a given overall spending level on education, while households can make their schooling choice conditional on this spending. Even though under each timing assumption people have perfect foresight, we will see that timing makes an important difference. For the following analysis, we return to the assumption of an even distribution of political power, i.e. $\bar{x} = 0$.

In the new timing, the government sets the tax rate at the beginning of the period. Since the tax base is independent of the schooling choice, this is equivalent to determining total spending on public education. After the tax is set, parents choose fertility and public versus private education for their children. Public schooling per child will then be given by the ratio of pre-committed total spending to the number of children in public schools. Since the government has perfect foresight, the problem can be solved backwards by first determining individual decisions as a function of policies, and then choosing policies taking this dependency into account.

Since fertility choices conditional on schooling are not affected by taxes, fertility rates will be, as above, determined by equations (3) and (5). Private education spending is also unaffected by the new timing of decisions and is given by equation (4). The participation decision is determined by the threshold defined in Lemma 2, which is now defined in terms of actual schooling quality s:

$$\tilde{x}[s] = \frac{1-\eta}{\delta\phi\eta}\, s. \tag{17}$$

We also redefine the endogenous fraction of children participating in the public education system as a function of actual quality:

$$\Psi[s] = \begin{cases} 0 & \text{if} \quad \tilde{x}[s] < 1-\sigma, \\ \dfrac{\tilde{x}[s]-(1-\sigma)}{2\sigma} & \text{if} \quad 1-\sigma \leq \tilde{x}[s] \leq 1+\sigma, \\ 1 & \text{if} \quad \tilde{x}[s] > 1+\sigma. \end{cases} \tag{18}$$

From Equation (9), the link between taxes and expenditures is given by:

$$v = \Psi[s]\frac{\gamma}{\phi}\, s. \tag{19}$$

The objective function modeling the voting process is the same as before, but Ψ

and $\tilde{x}$ are now endogenous:

$$\Omega[s] \equiv \int_0^{\tilde{x}[s]} u[x, v, n^s, 0, s] g[x] dx + \int_{\tilde{x}[s]}^{\infty} u[x, v, n^e, e[x], 0] g[x] dx. \tag{20}$$

The structure of the problem is similar to a standard Ramsey (1927) problem, where the government chooses optimal taxes taking into account the reaction of private agents. Once again three regimes are possible: fully public ($\Psi[s] = 1$), segregation ($1 > \Psi[s] > 0$), and fully private ($\Psi[s] = 0$). In the segregation case, the first-order condition for optimization is as follows:

$$\int_0^{\tilde{x}[s]} \left(\frac{\partial u}{\partial v} \frac{\partial v}{\partial s} + \frac{\partial u}{\partial s} \right) g[x] dx + \int_{\tilde{x}[s]}^{\infty} \left(\frac{\partial u}{\partial v} \frac{\partial v}{\partial s} + \frac{\partial u}{\partial s} \right) g[x] dx$$
$$+ \int_0^{\tilde{x}[s]} \frac{\partial u}{\partial v} \frac{\partial v}{\partial \Psi} \frac{\partial \Psi}{\partial s} g[x] dx + \int_{\tilde{x}[s]}^{\infty} \frac{\partial u}{\partial v} \frac{\partial v}{\partial \Psi} \frac{\partial \Psi}{\partial s} g[x] dx = 0.$$

The first line of this optimality condition is the same as the one we get in the problem without commitment. The second line is a new term which arises from the endogenous dependency of Ψ on s. This term is always negative. The new negative term implies that under government commitment, the optimal s is lower than under no-commitment, as long as the solution for Ψ is interior. Intuitively, the government now takes into account that a marginal increase in s increases the number of families who use public schools. On the margin this lowers the value of the objective function, since the marginal family is just indifferent between private and public schooling, but imposes a fiscal burden on the rest of the population once it switches from private to public school.

In the fully private and public regimes, participation $\Psi[s]$ is locally independent of s, as long as the marginal family strictly prefers its current schooling choice. The additional term is therefore zero, and hence the optimal schooling choice of s does not depend on government commitment. The following proposition summarizes the result.

Proposition 6 (Equilibrium with commitment)
An equilibrium with commitment exists. Public school quality is lower than or equal to the level reached without commitment. The inequality is strict if participation Ψ satisfies:

$0 < \Psi < 1$.

Existence is guaranteed because the objective function is continuous on a compact set. The equilibrium is not guaranteed to be unique, however, because the objective function is not globally concave. In particular, it has kinks at the values of s corresponding to $\tilde{x}[s] = 1 - \sigma$ and $\tilde{x}[s] = 1 + \sigma$. However, multiplicity occurs only for knife-edge cases.

If we extend this model to concentrated political power as in Section 4, we no longer get generic multiplicity of equilibria. Under the original timing, multiple equilibria arose as self-fulfilling prophecies. With government commitment, the government moves first and chooses the generically unique equilibrium that maximizes the objective function.

We therefore see that the relative timing of the decisions taken by individual households and by the government has an important bearing on the positive implications of our theory. Which timing, then, should be considered the most realistic? There is no general answer to this question, as political decision horizons can vary substantially from country to country. Still, it is useful to consider as a benchmark the common case of a government that adjusts the education budget (which determines the quality of public schooling) at an annual frequency. As far as fertility decisions are concerned, the realistic assumption is that households move before the government does. Children generally enter school at age six, so that at the very minimum, six years pass from the fertility decision until schooling actually begins. It is hard to imagine that the government commits to a schooling quality more than six years ahead of time, without any possibility of later adjustments.

In contrast, matters are less clear-cut when it comes to the choice of an education system (i.e., whether to send one's child to public or private school). We have already analyzed the case where parents make this choice before the government decides on school quality. What would happen if households chose fertility before the vote on schooling quality, but could adjust their choice of public versus private schooling after the vote? As we will see, a framework in which households make at least one decision before the government moves leads to implications similar to those under our original timing, where the government moves last.

In this intermediate case, when households choose fertility, they do so under perfect foresight regarding the future quality of schools. There will be an income threshold $\bar{x}$ below which people have large families (corresponding to the expectation of public schooling). The objective of the voting process takes three different forms depending on how the threshold for private education $\tilde{x}[s]$ compares to the threshold for small families $\bar{x}$. For $\bar{x} < \tilde{x}[s]$, it is given by:

$$\Omega[s] = \int_0^{\bar{x}} u[x, v, n^s, 0, s] g[x] dx + \int_{\bar{x}}^{\tilde{x}[s]} u[x, v, n^e, 0, s] g[x] dx \\ + \int_{\tilde{x}[s]}^{\infty} u[x, v, n^e, e[x], 0] g[x] dx,$$

for $\bar{x} = \tilde{x}[s]$, we have

$$\Omega[s] = \int_0^{\tilde{x}[s]} u[x, v, n^s, 0, s] g[x] dx + \int_{\tilde{x}[s]}^{\infty} u[x, v, n^e, e[x], 0] g[x] dx, \tag{21}$$

and for $\bar{x} > \tilde{x}[s]$, we have:

$$\Omega[s] = \int_0^{\tilde{x}[s]} u[x, v, n^s, 0, s] g[x] dx + \int_{\tilde{x}[s]}^{\bar{x}} u[x, v, n^s, e[x], 0] g[x] dx \\ + \int_{\bar{x}}^{\infty} u[x, v, n^e, e[x], 0] g[x] dx.$$

If $\bar{x} \neq \tilde{x}[s]$, as in the previous case the first-order condition for optimality has an additional term related to the marginal impact of s on $\tilde{x}[s]$. In equilibrium, however, agents have perfect foresight, and $\bar{x} = \tilde{x}[s]$ will hold. Consider the s that maximizes the objective function holding $\tilde{x}[s]$ constant at $\bar{x}$, as in our original timing. In Equation (21), in a neighborhood around this s the marginal effect of a change in s on $\tilde{x}$ is zero. The reason is that agents below $\bar{x}$ have chosen large families in expectation of using public schools, whereas families above $\bar{x} = \tilde{x}[s]$ have chosen small families in expectation of private schooling. Families close to the threshold therefore strictly prefer their expected schooling choice to the alternative. Thus for $\bar{x} = \tilde{x}[s]$ which occurs in equilibrium, the first-order condition is as in our original timing. If the solution is interior, this implies that the outcome has to be the same.[16]

To summarize, whether the model generates multiplicity of equilibria depends crucially on the timing of private decisions relative to the determination of government policy. If parents make decisions that lock them into specific choices for their children for a long time, whereas the government can adjust the quality of public education more frequently, multiple equilibria are possible. In the real world, the strength of these lock-in effects would depend on a number of features that are not modeled explicitly in our theory. For example, in some countries educational segregation is linked to residential segregation, i.e., there are districts where mostly rich people live who use private schools, while poorer districts are served by public schools. In such an environment, a switch in the type of schooling would also entail a switch of residence, and maybe even a switch of jobs if the distances are large enough. Clearly, in such an environment the lock-in into a particular schooling type would be much stronger than in a country where private and public schools are located right next to each other, with few hurdles to switching schools.

6 Empirical Evidence

Our theory makes predictions about how the quality and extent of private and public schooling are determined at the aggregate level, and about how schooling and fertility choices vary across households within a given political entity. In this section, we compare these predictions to data. We start by focusing on state-level variation in the extent and quality of public education in the United States. This setting is well suited to examining the predictions of our theory for democratic countries, since all U.S. states operate within the same overall political framework, while exhibiting considerable variation in schooling policies as well as the distribution of income. Moreover, we are able to link state-level evidence to household data from the U.S. Census to assess the micro implications

[16]Depending on parameters, however, under the intermediate timing there can also be additional corner solutions. The original and intermediate timing lead to the same equilibria if the lock-in effect through fertility is sufficiently strong. The strength of the lock-in effect, in turn, depends on the fertility differential between parents with children in public and private schools.

of our theory. We then extend the analysis to cross-country data, which allows us to probe the theory's predictions for non-democratic countries. Here we use data from the OECD and the World Bank on public and private education spending, as well as micro data from the OECD Programme for International Student Assessment (PISA).

6.1 Inequality, fertility, and schooling across U.S. states

Our model predicts that in a democracy, the choice of public versus private schooling and the level of funding of public schooling are driven by income inequality (see Proposition 3). In particular, a state with higher income inequality should exhibit a higher share of private schooling, lower overall spending on public schooling, but higher public education spending per student. In addition, the model predicts that a high-inequality state will have a relatively low fertility rate, because parents who send their children to private school economize on fertility. In this section, we examine whether these predictions hold up across U.S. states.

We computed state-level measures of income inequality, average fertility, and the share of private schooling from the 2000 U.S. Census.[17] We correlate these variables with a number of measures of the spending on and the quality of public schooling. In line with the setup of our theory, we focus on financial measures.[18] As an overall spending measure, we use public education spending per capita in each state (this corresponds to the tax rate v in the model). For the quality of public education (corresponding to the variable s in the model), we consider three alternative measures. "Total Current Expenditure per Student" is a measure of total spending for day-to-day operation of schools, which includes all expenditures of public schools apart from debt repayments, capital outlays, and programs outside of preschool to grade 12. One concern with this broad measure is that it includes some items that may not have a direct educational impact. There-

[17]The data is from the one-percent sample of the 2000 U.S. Census, made available at www.ipums.org by Ruggles et al. (2004).

[18]There may also be differences in how efficiently a given amount of spending is converted into "effective education," but our theory makes no predictions in this dimension and assumes that all states are at the efficiency frontier.

Table 1: Correlation of Inequality and Share of Private Schooling with Fertility, Education Spending, and the Quality of Public Schooling across U.S. States

	Gini coefficient	Private school share
Private school share	0.39 (2.98)	
Public spending per capita	-0.45 (-3.55)	-0.10 (-0.68)
Public spending per student	0.26 (1.86)	0.52 (4.31)
Public instruction spending per student	0.18 (1.25)	0.49 (3.92)
Mean teacher salary in public schools	0.25 (1.78)	0.57 (4.80)
Average number of children	-0.47 (-3.75)	-0.40 (-3.03)

t-Statistics in parentheses. "Gini Coefficient" is computed on 1999 household income by state (data from 2000 U.S. Census). "Share in Private School" is the number of households with at least half of their school-age children in private school as a fraction of the total number of households with at least one child in school (data from 2000 U.S. Census). "Number of Children" is the average number of children per household in the same data set, where children are counted only if the head of household is their parent and if they are currently living in the household. Measures of education spending and quality of education are defined in the text.

fore, we also use the variable "Total Instruction Expenditure per Student," which includes only expenditures associated directly with student-teacher interaction such as teacher salaries and benefits, textbooks and other teaching supplies, and purchased instructional services. Finally, as an alternative measure of the quality of instruction we use "Mean Teacher Salary," an estimate of the average annual salary of teachers in public elementary and secondary schools.[19]

Table 1 shows how income inequality (i.e., the Gini coefficient on household income by state) and the share of private schooling correlate with fertility and measures of education spending and quality across states. The correlations are in line with the predictions of Proposition 3. In particular, the correlation between inequality and the share of private schooling is positive, whereas the correlation between inequality and per-capita spending on public education is negative. Taken

[19]The expenditure measures are from the National Center for Education Statistics, "Revenues and Expenditures for Public Elementary and Secondary Education," School Year 2000-2001. The teacher salary data is provided by the National Education Association.

by themselves, these results might seem to suggest that more inequality leads to less redistribution in the sense of lower support for public education. However, this is not the case when we consider the quality of public education rather than overall spending. All three measures of the quality of public education are positively correlated with inequality.[20] This verifies the third part of Proposition 3.

The surprising finding that the correlation coefficients of education spending per capita and education spending per student are of opposite sign can be accounted for by the effect of private schooling on the quality of public schooling. As inequality rises, more students use private schools, which makes it more affordable to offer a high-quality education to those still in public schools. This effect can be seen even more clearly when we correlate education quality with the share of students in private school (second column of Table 1). For all three measures, the correlation is positive and highly significant. Hence, the theoretical implication that as the share of private schooling increases, the quality of the public school should increase as well seems to be well supported in the U.S. data.

The finding has important implications for the relationship of inequality and redistribution. If one looked only at aggregate spending, one might think that more inequality leads to less redistribution, as posited by Bénabou (2000), among others. However, the per-person transfer to poorer households (i.e., the education quality provided to households using public schools) does in fact go up. This increase is possible because more inequality leads to more targeted transfers, as richer households opt out of the public system.

The last row of Table 1 examines predictions for fertility rates. We find that states with more inequality and a higher share of private schooling have a lower fertility rate. This outcome is in accordance with our model: parents economize on the number of children if the direct cost of education is high.

[20] The correlation is significant at the 10 percent level for total expenditure per student as well as mean teacher salary.

6.2 Determinants of fertility and public versus private schooling at the household level

We now examine more closely the inner workings of our model with the help of micro data from the U.S. Census. We want to establish whether the model paints a realistic picture of the interaction between household income, private choices on education and fertility, and the quality of public schooling. This will be useful to assess whether our model indeed provides a plausible mechanism for generating the observed macro correlations. Here, we draw on data on household income, family size (i.e., the household head's own children living in the household), public versus private schooling (for school-age children), and a number of demographic controls from the one-percent sample of the 2000 U.S. Census.

In the model, a household's decisions on fertility and private versus public schooling depend on two variables: income and the quality of public schooling (see Lemma 2 and the preceding discussion). In particular, richer households are predicted to be more likely to choose private schools and to have lower fertility rates. The strength of the income effect depends on the quality of public schooling; for example, if public schooling is of very high quality, even fairly rich households will use public schools. To examine these predictions, Tables 2 and 3 show regressions of family size and private schooling on household income and a number of controls.[21] We use an ordered logit specification for the fertility choice and a logit specification for the private education choice. All regressions contain dummy variables for the age of the household head as well as for the state of residence (the effect of further controls is discussed below).

The first column of each table presents results for regressions that include only household income in addition to the standard controls. As predicted by the theory, an increase in income is associated with a higher probability of using private schooling and lower fertility.[22] However, in this specification the relationship

[21]In order to be able to include households that report zero income, we add $10 to household income before taking logs. The results are qualitatively the same if we shift up incomes by $100 or $500 instead.

[22]The positive effect of income on the probability of private schooling has also been documented by Cohen-Zada and Justman (2003) and Epple, Figlio, and Romano (2004); see also Nechyba (2006). However, these studies do not consider fertility choices and the interaction of the quality of public schooling across states with income effects.

Table 2: Estimation Results: Ordered Logit Regression of Number of Children on Income and Quality of Public Education

		Measure of quality of public education		
		Total expenditure per student	Instruction expenditure per student	Mean teacher salary
Log household income	-0.012 (-1.11)	-0.808 (-3.15)	-0.685 (-3.08)	-0.688 (-1.09)
Interaction income $\times$ quality		0.089 (3.15)	0.080 (3.07)	0.063 (1.07)
Total income effect at average quality	-0.012 (-1.11)	-0.013 (-1.27)	-0.013 (-1.26)	-0.013 (-1.13)

t-Statistics in parentheses (standard errors are clustered by state). Data from 2000 U.S. Census. 453,296 observations (households with children). State and age of household dummies in all regressions.

Table 3: Estimation Results: Logit Regression of Choice of Private Schooling on Income and Quality of Public Education

		Measure of quality of public education		
		Total expenditure per student	Instruction expenditure per student	Mean teacher salary
Log household income	0.557 (17.98)	4.021 (5.69)	3.280 (5.90)	4.894 (2.38)
Interaction income $\times$ quality		-0.388 (-4.94)	-0.323 (-4.96)	-0.406 (-2.09)
Total income effect at average quality	0.557 (17.98)	0.569 (28.65)	0.568 (27.01)	0.565 (21.76)

t-Statistics in parentheses (standard errors are clustered by state). Data from 2000 U.S. Census. 311,625 observations (households with children in school). State and age of household dummies in all regressions. Choice of Private Schooling variable takes the value 1 if at least half of the school-age children in the household attend private schools.

between household income and fertility is not significant at conventional levels. The remaining columns focus on the joint effect of household income and the quality of public schooling in determining private choices. Each regression contains an additional interaction term of household income with one of our three measures of the quality of public schooling. Notice that schooling quality is measured at the state level, not the household level.[23] In essence, we are still estimating a micro relationship between household income and private choices, but we allow the slope of this relationship to vary systematically across states with a high and a low quality of public education. We find that in both regressions and for all three measures of the quality of public schooling, the estimated coefficient on the interaction term is of the opposite sign as the coefficient on income, which implies that the effect of income on household choices diminishes as the quality of public schooling goes up. When the interaction term is included, all parameter estimates are highly significant, with the one exception of the fertility regression using mean teacher salary as a quality measure.

The size of the interaction terms implies substantial variation in the steepness of the income-fertility and income-private schooling relationships across states with a low and high quality of public schooling. In the states with the highest quality of public education, these relationships are essentially flat. This is exactly what one would expect based on the theory: states with high-quality public schooling are close to a fully public regime, i.e., most parents use public schools regardless of income, and fertility varies little across income groups.

The regression results are robust with respect to a number of changes to the specification of the model. We explored sensitivity to racial composition by estimating the regressions separately by race and by including race dummies; we checked urban/rural differences by including a metropolitan area dummy; and we ran the regressions on restricted samples limiting the age range of the included households. Generally, the sign and significance of the interaction term in the two regressions are robust to these changes, as are the sign and significance of the total income effect in the education equation. The sign of the total

[23]The fact that schooling quality is a state-level variable also precludes using it in the regression directly, because our regressions already contain state dummies. As a robustness test, we also carried out regressions without state dummies and schooling quality as an included variable, with overall similar results.

income effect in the fertility regression turns out to be more sensitive. In particular, for black and Hispanic households the total income effect is strongly negative, whereas for white households it is positive. However, when we restrict the sample to the ages 25–45, the total income effect once again is negative and significant. This suggests that for older white people, the slope of the relation between fertility and income can be reversed.[24] However, even in the case of a positive slope, the sign of the interaction term remains the same.

6.3 Inequality, fertility, and schooling across countries

We now turn to the determinants of education systems across countries. Compared to our analysis of education in U.S. states, cross-country data pose additional challenges. There are substantial differences in the level of development and in unobserved variables such as the political system, religious values etc. across countries which could have independent effects on the variables of interest.[25] Doing full justice to the arising empirical issues is beyond the scope of this paper. Therefore, we focus on documenting the fundamental correlations and micro relationships implied by our theory.

The OECD provides internationally comparable data on the relative proportions of public and private investment in education for the period 1985–1998. In most countries, private sector expenditure is comprised mainly of household expenditures on tuition and other fees. The exception is Germany, where nearly all private expenditure is accounted for by contributions from the business sector to the system of apprenticeship at the upper secondary level. For primary and lower secondary education, there is little private funding in Germany. In 1998,

[24]To some extent, this finding could be due to the fact that in the Census, we observe only children who still live in the household. If rich, white households have children relatively late in life, they would appear to have unusually many children in their household at a time when other parents' children have already left to form their own households. This type of effect is not picked up by a simple age dummy, but can be partially addressed by restricting the age range of households included in the sample.

[25]The literature contains few empirical studies on the determinants of the mix between public and private education across countries. One exception is James (1993), who regresses private enrollments shares for 50 countries around 1980 on a number of determinants, and concludes that cultural factors such as religious competition and linguistic heterogeneity play an important role. However, the small number of observations compared to the number of explanatory variables casts some doubt on the robustness of the results.

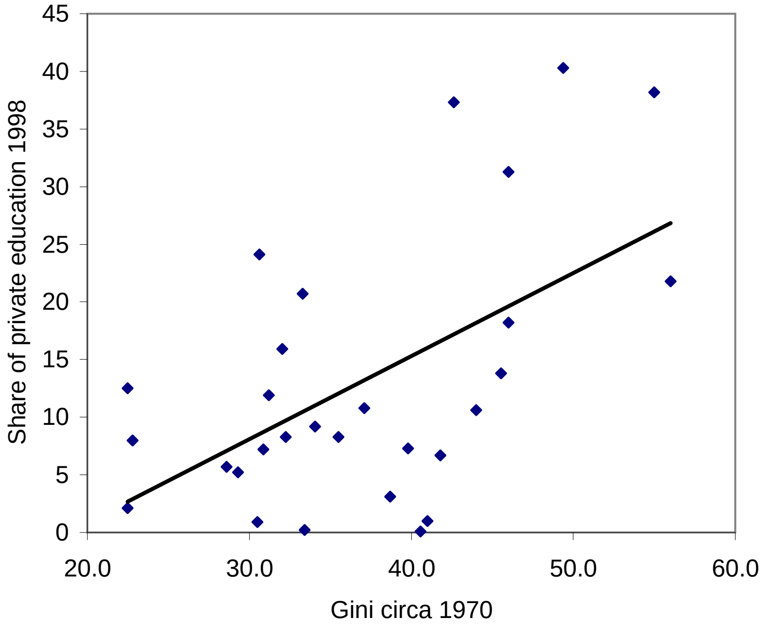


Figure 3: Inequality and education systems across countries

the data set contains information on a number of non-OECD countries (Israel, Uruguay, Czech Republic, Turkey, Argentina, Indonesia, Chile, Peru, Philippines, and Thailand). With observations on 31 countries, we can investigate whether inequality is a good predictor of private funding. Computing the correlation between the Gini coefficient for income inequality in 1970 (from Deininger and Squire 1996) and the share of private funding in 1998, we find that the correlation is positive and strong with a coefficient of 0.44 (t-stat=2.64).[26] The correlation increases to 0.55 (t-stat=3.55) if we consider only the primary and secondary levels of education. Figure 3 presents the cross plot of the private share in primary and secondary education with the Gini coefficient.

We turn next to micro data from the OECD Programme for International Student Assessment (PISA), collected in the year 2000 on 15 year-old students in the principal industrialized countries. It includes a student questionnaire gathering information about the student's family and a school questionnaire covering information on the extent of public funding and the public or private administration of schools. We focus on four variables in the PISA database. The Inter-

[26]We use the Gini coefficient in 1970 to address possible reverse causality from schooling to inequality.

national Socioeconomic Index (ISEI) captures the attributes of occupations that convert parents' education into income. It was obtained by mapping parents' occupational codes onto an index of occupational status, developed by Ganzeboom, De Graaf, and Treiman (1992). This index provides a rough measure of household income and human capital (unfortunately, household income itself is not contained in the data base). Using the index, students are assigned to one of four social classes.[27] The second student-specific variable in our data set is the number of siblings. At the school level, our data set contains information on the funding sources of schools and on whether a school is publicly or privately run. For school funding, our variable is the percentage of total funding that stems from government sources, as opposed to fees paid by parents, benefactors, or other sources of income.

For each country, we computed average school characteristics for the four social classes. For each group, we report the average share of education spending covered by public sources (the subsidization rate), the share of students in private schools, and the average fertility rate. The detailed results are provided in Appendix B. Overall, the findings once again are consistent with the theory: in the vast majority of cases, participation in private schooling increases and fertility decreases with social status.

An interesting feature of the PISA data is that it covers countries that appear to be characterized by different schooling regimes. In particular, a number of countries come close to what could be described as a fully public regime. To investigate the effects of having a fully public schooling regime, we define countries as fully public if the difference in the subsidization rate between the highest and lowest social class is less than five percent.[28] The remaining countries are classified as

[27]Typical occupations in the lowest class (between 16 and 35 points on the ISEI scale) include small-scale farmer, metalworker, mechanic, taxi or truck driver, and waiter/waitress. Between 35 and 53 index points, the most common occupations are bookkeeping, sales, small business management, and nursing. As the required skills increase, so does the status of the occupation. Between 54 and 70 points, typical occupations are marketing management, teaching, civil engineering, and accounting. In the highest class (from 71 to 90 points), occupations include medicine, university teaching, and law.

[28]This group includes Hungary, the Czech Republic, Denmark, Finland, Germany, Iceland, Latvia, The Netherlands, Norway, Russia and Sweden. Appendix B also provides the proportion of students attending private schools. The school type is determined by the question "Is your school a public or a private school." Here public schools are those managed by a public

Table 4: Summary Statistics for Countries with Different Education Regimes

	Number of countries	Gini in the 1980s	Share of public funding	Funding difference between poor and rich	Fertility differential between poor and rich
Fully public regime	11	24.7	0.96	0.00	0.36
Segregation regime	18	34.6	0.81	0.14	0.47
Top 5 most segregated	5	44.6	0.69	0.25	0.69
Correlation with Gini			-0.58 (3.65)	0.76 (5.96)	0.53 (3.21)

t-Statistics in parentheses.

being in the segregation regime. We also consider separately the five countries with the highest difference in the public subsidization rate of the lowest and the highest social class (Austria, Australia, Brazil, Mexico, and Spain). In this group, the difference between the subsidization rate of schools attended by members of the top and bottom social classes averages 25 percent.

Table 4 provides a number of statistics for the groups of countries with different education regimes. Not surprisingly, in the fully public group the level of public subsidization is particularly high, with an average of 96 percent. These countries are also characterized by low income inequality (average Gini: 24.7), and the fertility differential between the bottom and top social classes is only 0.36.[29] In contrast, the group of countries in the segregation regime has an average Gini of 34.6 and a fertility differential of 0.47. The five countries with the highest level of segregation also top the list in terms of inequality and differential fertility: the average Gini coefficient is 44.6 in this group, and the fertility differential between the bottom and top social classes amounts to 0.59. The last row of Table 4 presents correlation coefficients between the Gini coefficient and the other variables across all countries in the data set. As predicted by the theory, in countries with higher income inequality average public funding is lower, the subsidization rate is more sensitive to social class, and fertility differentials are larger.[30]

6.4 Public education spending and democracy

We now turn to the final implication of our theory, the effect of democracy on education politics. Given that data on private spending on education is available

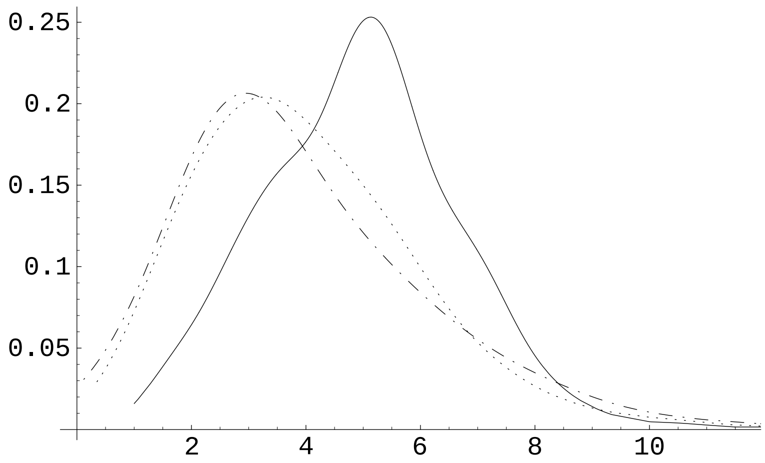
education authority, a government agency, or a governing board that is appointed either by the government directly or elected by public franchise. While we could have used this variable to define countries as fully public, for our purposes the public subsidization rate is a better indicator of public versus private schooling than the school type, because "private school" can mean different things in different countries. In Belgium, for example, most schools are nominally private, yet are entirely publicly funded. Nevertheless, using the school type variable instead of the school funding variable leads to similar results.

[29] In all the countries we find that the fertility of the lowest social class exceeds the fertility of the highest social group. In a majority of countries, the relationship between fertility and social status is monotonically decreasing; in some countries, it is U-shaped.

[30] One concern here is a reverse causality link whereby school segregation leads to more inequality. The problem is mitigated by the fact that we use Gini coefficients measured 20 years before the observed schooling outcomes.

Table 5: Public Spending on Education in Democracies and Non-Democracies

Democracy index	Observations	Mean	Variance
Free (= 1)	1020	4.96	3.08
Partially free ($1 < x \leq 4$)	836	4.11	7.07
Non-free ($4 < x \leq 7$)	644	4.07	8.33



Legend: Free (solid line), partially free (dots), non-free (dashes).
Note: Density estimation using the NonParametrix.m Package by Bernard Gress, 2004

Figure 4: Density of public education spending (percent of GDP)

Table 6: Mean and Variance Tests for Public Education Spending in Democracies and Non-Democracies

	Mean difference test		Variance ratio test	
	Partially free	Non-free	Partially free	Non-free
Free	0.85 (0.00)	0.89 (0.00)	0.44 (0.00)	0.37 (0.00)
Partially free		0.03 (0.82)		0.85 (0.03)

p-values in parentheses.

for only a few countries, we focus on public spending on education as a fraction of GDP. Here we have a sample of 158 countries covering the period 1970-2002 (with some missing observations; data from World Bank Development Indicators). We divide the sample into three groups, based on their level of democracy. As a democracy indicator, we use the political-rights index from the Freedom in the World Country Ratings. The index lies on a one-to-seven scale, with one representing the highest degree of freedom. We assign the countries into three groups, where "free" countries have an index of one, "partially free" have values from two to four, and "non-free" countries have values from five to seven.

Table 5 displays the mean and variance of public spending on education for the three groups of countries. The mean of spending is increasing with democracy, whereas the variance is decreasing. Figure 4 presents a density estimation of the entire distribution of public spending as a share of GDP for the three groups. The density for partially free and non-free countries displays a lower mean and a higher variance. Two-tailed tests of whether the differences are significant are provided in Table 6. The mean in democratic (free) countries is significantly different from the one in the two other groups. The variance in the non-free countries is significantly higher than in the partially free-countries, where the variance is higher than in the free group. These findings are in line with the predictions of our theory for the case of an uneven distribution of political power (see Propositions 4 and 5). Our mechanism is not the only possible explanation for the observed high variance in public educations pending in non-democracies, but it is encouraging that the predictions of the model are in line with data along this dimension also.

7 Conclusions

The education sector is a main area of government intervention in every country in the world. At the same time, governments generally are not the sole providers of education; education systems often display a juxtaposition of public and privately funded institutions. The degree of private involvement in the provision of education varies a great deal across countries, ranging from fully public systems as in some European countries to segregated systems as in parts of the United

States. In this paper, we try to understand how countries choose the mix of public and private education and how the presence of private schools affects the quality of public education.

First, we conclude that high inequality maps into a segregated education system. In our model's segregated system, the quality of public schools is sufficiently low to induce rich households to pay for private schools to enhance the education of their children. When inequality is low, on the other hand, the rich decide to send their children to public schools, so that they avoid paying for education twice (first through taxes, second through private schools). The prediction of a strong relationship between inequality and the extent of public schooling is in line with the empirical evidence. In both cross-country data and cross-state data in the U.S., we find that public spending on education is negatively related to income inequality.

Second, we find that as long as the poor have equal weight in the political system, a larger share of private schooling is associated with a higher quality of public schooling. While total tax revenue declines as the share of private schooling increases, the number of students who use public schools declines even faster, implying that the funding level per student increases. Thus, even though an increase in inequality and the associated increase in the share of private schooling reduce the total amount of redistribution, the transfers to public-school parents become more targeted, leaving the poor better off.

Turning to the role of political power, we find that the quality and extent of public schooling generally increases with the political weight of the poor. In addition, in societies that are dominated politically by the rich multiple equilibria in the determination of education spending may arise. When the rich are in charge, there is a complementarity between the number of rich people participating in public schools and their quality. For given initial conditions, such a country may have either a high-quality public schooling system in which many or all of the rich participate, or a low-quality system with all the rich using private schools. Despite the multiplicity, however, we find that spending on public education is never higher in a society dominated by the rich than in an otherwise identical economy where the poor have equal power. The model therefore offers an explanation for why non-democratic countries spend on average a smaller fraction of GDP on public education than democracies, whereas the variance of spending across countries is higher among non-democracies.

An important question for future research is why public education was first widely introduced in the nineteenth century during the second phase of the Industrial Revolution. Galor and Moav (2006) argue that in this period, capitalists began to have an interest in public education, because of complementarities between physical and human capital. Therefore, technological change strengthening this complementarity may have contributed to the introduction of public schooling. Galor, Moav, and Vollrath (2006) extend this analysis by distinguishing different sources of wealth. If land is less complementary to human capital than it is to physical capital, a conflict of interest arises between land-owners and capitalists. The outcome of this conflict depends on the distribution of wealth and land ownership.

In our model, public schooling always arises if political power is shared equally. The theory therefore points to the expansion of voting rights in the nineteenth century as a key explanation for the introduction of public schooling. Yet the question of why voting rights were expanded in the first place remains open. The theory of Galor and Moav (2006) offers one potential explanation. Acemoglu and Robinson (2000), however, point in a different direction: the rich shared power in order to avoid the threat of a revolution. In either case, given that the poor did gain political influence, in our model the introduction of public schooling is a necessary consequence. Once the public education system is in place, its size depends on the evolution of the income distribution. With this observation, the model points to the decline in income inequality around the turn of the century as a potential explanation for the further expansion of public education after it was first introduced.

References

Acemoglu, Daron and James A. Robinson. 2000. "Why Did the West Extend the Franchise? Democracy, Inequality and Growth in Historical Perspective." *Quarterly Journal of Economics* 115 (4): 1167–99.

Alderman, Harold, Peter F. Orazem, and Elizabeth M. Paterno. 2001. "School Quality, School Cost, and the Public/Private School Choices of Low-income Households in Pakistan." *Journal of Human Resources* 36 (2): 304–326.

Alesina, Alberto and Dani Rodrik. 1994. "Distributive Politics and Economic Growth." *Quarterly Journal of Economics* 109 (2): 465–90.

Bearse, Peter, Gerhard Glomm, and Debra M. Patterson. 2005. "Endogenous Public Expenditures on Education." *Journal of Public Economic Theory* 7 (4): 561–77.

Bedi, Arjun S. and Ashish Garg. 2000. "The Effectiveness of Private versus Public Schools: The Case of Indonesia." *Journal of Development Economics* 61 (2): 463–494.

Bénabou, Roland. 1996. "Inequality and Growth." *NBER Macroeconomics Annual*, pp. 11–74.

———. 2000. "Unequal Societies: Income Distribution and the Social Contract." *American Economic Review* 90 (1): 96–129.

Bernheim, Douglas and Michael Whinston. 1986. "Menu Auctions, Resource Allocation, and Economic Influence." *Quarterly Journal of Economics* 101 (1): 1–31.

Besley, Timothy and Stephen Coate. 1991. "Public Provision of Private Goods and the Redistribution of Income." *American Economic Review* 81 (4): 979–84.

Cohen-Zada, Danny and Moshe Justman. 2003. "The Political Economy of School Choice: Linking Theory and Evidence." *Journal of Urban Economics* 54 (2): 277–308.

Coughlin, Peter and Shmuel Nitzan. 1981. "Electoral Outcomes with Probabilistic Voting and Nash Social Welfare Maxima." *Journal of Public Economics* 15 (1): 113–21.

de la Croix, David and Matthias Doepke. 2003. "Inequality and Growth: Why Differential Fertility Matters." *American Economic Review* 93 (4): 1091–113.

———. 2004. "Public versus Private Education when Differential Fertility Matters." *Journal of Development Economics* 73 (2): 607–29.

Deininger, Klaus and Lyn Squire. 1996. "Measuring Income Inequality: A New Database." Development Discussion Paper No. 537, Harvard Institute for International Development.

Diamond, Douglas W. and Philip H. Dybvig. 1983. "Bank Runs, Deposit Insurance, and Liquidity." *Journal of Political Economy* 91 (3): 401–19.

Doepke, Matthias and Fabrizio Zilibotti. 2005. "The Macroeconomics of Child Labor Regulation." *American Economic Review* 95 (5): 1492–524.

Epple, Dennis and Richard E. Romano. 1996a. "Ends Against the Middle: Determining Public Service Provision when there are Private Alternatives." *Journal of Public Economics* 62 (3): 297–325.

———. 1996b. "Public Provision of Private Goods." *Journal of Political Economy* 104 (1): 57–84.

Epple, Dennis, David Figlio, and Richard Romano. 2004. "Competition Between Private and Public Schools: Testing Stratification and Pricing Predictions." *Journal of Public Economics* 88 (7): 1215–45.

Fernández, Raquel and Richard Rogerson. 1995. "On the Political Economy of Education Subsidies." *Review of Economic Studies* 62 (2): 249–62.

Galor, Oded and Omer Moav. 2006. "Das Human-Kapital: A Theory of the Demise of the Class Structure." *Review of Economic Studies* 73 (1): 85–117.

Galor, Oded, Omer Moav, and Dietrich Vollrath. 2006. "Inequality in Land Ownership, the Emergence of Human Capital Promoting Institutions and the Great Divergence." Unpublished Manuscript, Brown University.

Ganzeboom, Harry B.G., Paul M. De Graaf, and Donald J. Treiman. 1992. "A Standard International Socio-Economic Index of Occupational Status." *Social Science Research* 21 (1): 1–56.

Glomm, Gerhard and B. Ravikumar. 1992. "Public Versus Private Investment in Human Capital: Endogenous Growth and Income Inequality." *Journal of Political Economy* 100 (4): 818–834.

———. 1998. "Opting Out of Publicly Provided Services: A Majority Voting Result." *Social Choice and Welfare* 15 (2): 197–99.

Goldhaber, Dan D. 1996. "Public and Private High Schools: Is School Choice the Answer to the Productivity Problem?" *Economics of Education Review* 15 (2): 93–109.

Gradstein, Mark and Moshe Justman. 1997. "Democratic Choice of an Education System: Implications for Growth and Income Distribution." *Journal of Economic Growth* 2 (2): 169–83.

Hassler, John, Jose V. Rodriguez Mora, Kjetil Storesletten, and Fabrizio Zilibotti. 2003. "The Survival of the Welfare State." *American Economic Review* 93 (1): 87–112.

James, Estelle. 1993. "Why Do Different Countries Choose a Different Public-Private Mix of Educational Sevices?" *Journal of Human Resources* 28 (3): 571–592.

Katz, Michael L. and Carl Shapiro. 1985. "Network Externalities, Competition, and Compatibility." *American Economic Review* 75 (3): 424–440.

Kingdon, Geeta G. 1996. "The Quality and Efficiency of Private and Public Education: A Case-study of Urban India." *Oxford Bulletin of Economics and Statistics* 58 (1): 55–80.

Matsuyama, Kiminori. 1991. "Increasing Returns, Industrialization, and Indeterminacy of Equilibrium." *Quarterly Journal of Economics* 106 (2): 617–50.

Moav, Omer. 2005. "Cheap Children and the Persistence of Poverty." *Economic Journal* 115 (500): 88–110.

Neal, Derek. 1997. "The Effects of Catholic Secondary Schooling on Educational Achievement." *Journal of Labor Economics* 15 (1): 98–123.

Nechyba, Thomas J. 2006. "Income and Peer Quality Sorting in Public and Private Schools." Chapter 22 of *Handbook of the Economics of Education, Vol. 2*, edited by Eric A. Hanushek and Finis Welch. Amsterdam: North-Holland.

Persson, Torsten and Guido Tabellini. 1994. "Is Inequality Harmful for Growth? Theory and Evidence." *American Economic Review* 84 (3): 600–21.

———. 2000. *Political Economics: Explaining Economic Policy*. Cambridge, Massachusetts: MIT Press.

Ramsey, Frank P. 1927. "A Contribution to the Theory of Taxation." *Economic Journal* 37 (145): 47–61.

Ruggles, Steven, Matthew Sobek, Trent Alexander, Catherine A. Fitch, Ronald Goeken, Patricia Kelly Hall, Miriam King, and Chad Ronnander. 2004. "Integrated Public Use Microdata Series: Version 3.0." [Machine-readable database]. Minneapolis, MN: Minnesota Population Center.

Saint-Paul, Gilles and Thierry Verdier. 1997. "Power, Distributive Conflicts and Multiple Growth Paths." *Journal of Economic Growth* 2 (2): 155–168.

Stiglitz, Joseph E. 1974. "The Demand for Education in Public and Private School Systems." *Journal of Public Economics* 3 (4): 349–85.

Toma, Eugenia F. 1996. "Public Funding and Private Schooling Across Countries." *Journal of Law and Economics* 39 (2): 121–48.

A Technical Appendix

Proof of Lemma 1: From the budget constraint (2), total spending on children is given by $x\phi n + ne$. Substituting either $n = n^s$ and $e = 0$ or $n = n^e$ and $e = \eta\phi x/(1-\eta)$ yields that

$$x\phi n + ne = \frac{\gamma}{1+\gamma}x.$$

Taxable income therefore is

$$x(1-\phi n) - ne = \frac{1}{1+\gamma}x.$$

■

Proof of Lemma 2: We compute the level x such that a household with income x is indifferent between public and private by solving $u[x, v, n^s, 0, [E](s)] = u[x, v, n^e, e, 0]$:

$$\tilde{x} = \frac{1-\eta}{\delta\phi\eta}\,[E](s) \qquad\qquad \text{with: } \delta = (1-\eta)^{\frac{1}{\eta}}.$$

$\tilde{x}$ is bigger than zero and depends positively on $[E](s)$. If x is greater (resp. smaller) than $\tilde{x}$, $u[x, v, n^s, 0, [E](s)]$ is smaller (resp. greater) than $u[x, v, n^e, e, 0]$, and the household prefers private (resp. public) education, which proves the Lemma. ■

Proof of Proposition 1: The result follows from an application of the Brouwer fixed point theorem. Given (11), the equilibrium expected schooling quality $\mathrm{E}[s]$ and actual quality s lie in the interval:

$$\mathrm{E}[s], s \in \left[\frac{\eta\phi}{1+\gamma\eta}, \eta\phi\right] \tag{22}$$

We now define a mapping Δ from $\mathrm{E}[s]$ into s which maps this interval into itself. Since an equilibrium requires $\mathrm{E}[s] = s$, a unique equilibrium exists if the mapping has unique fixed point.

Given expected schooling quality $\mathrm{E}[s]$, according to Lemma 2 and equation (7) the fraction of families participating in public education is given by:

$$\Psi(\mathrm{E}[s]) = \max\left\{\min\left\{\frac{1-\eta}{2\sigma\delta\phi\eta}\,\mathrm{E}[s] - \frac{1-\sigma}{2\sigma}, 1\right\}, 0\right\}.$$

This function is (weakly) increasing in $\mathrm{E}[s]$; the higher the expected quality of public education, the more parents are going to prefer using the public sector.

We can now use (11) to map the expected education quality $\mathrm{E}[s]$ into the actual education quality s that would result from the political system if fraction $\Psi(\mathrm{E}[s])$ of families participated in the public system. This education quality $s = \Delta(\mathrm{E}[s])$ is given by:

$$\Delta(\mathrm{E}[s]) = \frac{\eta\phi}{1+\gamma\eta\Psi(\mathrm{E}[s])} = \frac{\eta\phi}{1+\gamma\eta\max\left\{\min\left\{\frac{1-\eta}{2\sigma\delta\phi\eta}\,\mathrm{E}[s]-\frac{1-\sigma}{2\sigma},1\right\},0\right\}}. \quad (23)$$

An equilibrium is characterized by a fixed point of $\Delta(\mathrm{E}[s])$, i.e., a schooling level s that satisfies $s = \Delta(s)$, so that the schooling quality s that is expected by the parents is identical to the one actually implemented in the political process. Given (23), Δ is a continuous, weakly decreasing function mapping the closed interval given in (22) into itself. The mapping therefore crosses the 45-degree line exactly once, and a unique equilibrium exists. ■

Proof of Proposition 2: We first show that the private regime is not an equilibrium outcome. In *a reductio ad absurdum* argument, we assume the existence of such a case. We start from the optimal value of s given in Equation (11). From this equation, we observe that as Ψ tends to zero, s tends to $\eta\phi$. With this quality of public schooling, the equilibrium income threshold (from Equation (6) is: $\tilde{x}[\eta\phi] = (1-\eta)/\delta$. For private education to be an equilibrium, this threshold should be lower than or equal to lowest income $1-\sigma$. Given the definition of $\delta = (1-\eta)^{1/\eta}$, we have that $\delta < 1-\eta$ which implies $x[\eta\phi] > 1 > 1-\sigma$. Hence, with a quality of public schools going to $\eta\phi$, it is always optimal for the poorest person to choose public education. Therefore, the private regime cannot arise in equilibrium.
If the public regime is an equilibrium, it has $\Psi = 1$ and $s = \eta\phi/(1+\gamma\eta)$ (from Equation (11)). For this to be an equilibrium, we need the richest person to send his children to public school, which requires $\tilde{x}[\eta\phi/(1+\gamma\eta)] \geq 1+\sigma$. This condition can be written:

$$\frac{1-\eta}{\delta(1+\gamma\eta)} \geq 1+\sigma.$$

If $\gamma \geq \hat{\gamma} = (1-\delta-\eta)/(\delta\eta)$, the right hand side of the inequality is below 1, and the inequality can never be satisfied. This condition links the taste for children γ to the weight of education η independently of σ. If $\gamma < \hat{\gamma}$, the above inequality can be rewritten as a condition on σ, which in the condition of the Proposition.
It remains to be shown that $\gamma < \hat{\gamma} \Leftrightarrow \Psi > 1/2$. $\Psi = 1/2$ implies that the equilibrium is segregated. We solve for the equilibrium value of Ψ, which is given by:

$$\Psi = \frac{-\gamma\,\delta\,\eta\,(1-\sigma) - 2\,\delta\,\sigma + \sqrt{8\,\gamma\,\delta\,\eta\,\sigma\,(1-\delta(1-\sigma)-\eta) + (\gamma\,\delta\,\eta(1-\sigma)+2\,\delta\,\sigma)^2}}{4\,\gamma\,\delta\,\eta\,\sigma}$$

There is only one value of γ for which this big expression is equal to $1/2$, and it is $\hat{\gamma}$. Since Ψ is a continuous function of γ, and that we already know that it can be equal to 1 for certain values of σ if $\gamma < \hat{\gamma}$, we conclude that $\Psi > 1/2$ for $\gamma < \hat{\gamma}$ and $\Psi < 1/2$ for $\gamma > \hat{\gamma}$. ■

Proof of Proposition 3: In the interior regime (segregation), we have from (6) and (7):

$$\Psi = \frac{\frac{1-\eta}{\delta\phi\eta}s - (1-\sigma)}{2\sigma}$$

Taking the derivative with respect to s, we obtain

$$\frac{\partial\Psi}{\partial\sigma} = \frac{2\sigma - 2\left[\frac{1-\eta}{\delta\phi\eta}s - (1-\sigma)\right]}{2\sigma} = \frac{1}{\sigma}\left(\frac{1}{2} - \Psi\right).$$

Hence,

$$\text{If } \Psi \in (0,1), \qquad \frac{\partial\Psi}{\partial\sigma} > 0 \Leftrightarrow \Psi < \frac{1}{2}. \tag{24}$$

In the public regime,

$$\Psi = 1, \qquad \Rightarrow \qquad \partial\Psi/\partial\sigma = 0. \tag{25}$$

Proposition 2 together with (12), (24), and (25) imply Proposition 3. ■

Proof of Proposition 4: As in the proof of Proposition 1, we will proceed by analyzing the mapping from expected schooling quality $\mathrm{E}[s]$ into actual quality s. Given (16), a schooling quality of zero is now possible, so that $\mathrm{E}[s]$ and s lie in the following interval:

$$\mathrm{E}[s], s \in [0, \eta\phi] \tag{26}$$

We now define a mapping $\bar{\Delta}$ from $\mathrm{E}[s]$ into s which maps this interval into itself. Since an equilibrium requires $\mathrm{E}[s] = s$, any equilibrium corresponds to a fixed point of the mapping.

Given expected schooling quality $\mathrm{E}[s]$, according to Lemma 2 and equation (7) the fraction of families participating in public education is given by:

$$\Psi(\mathrm{E}[s]) = \max\left\{\min\left\{\frac{1-\eta}{2\sigma\delta\phi\eta}\,\mathrm{E}[s] - \frac{1-\sigma}{2\sigma}, 1\right\}, 0\right\}. \tag{27}$$

This function is (weakly) increasing in $\mathrm{E}[s]$; the higher the expected quality of public education, the more parents are going to prefer using the public sector.

We can now use (16) to map the expected education quality $\mathrm{E}[s]$ into the actual education quality s that would result from the political system if fraction $\Psi(\mathrm{E}[s])$

of families participated in the public system. This education quality $s = \bar{\Delta}(\mathrm{E}[s])$ is given by:

$$\bar{\Delta}(\mathrm{E}[s]) = \max\left\{\frac{\eta\phi\left(1-\sigma-\bar{x}+2\sigma\Psi(\mathrm{E}[s])\right)}{\Psi(\mathrm{E}[s])\left(\gamma\eta\left(1-\sigma-\bar{x}+2\sigma\Psi(\mathrm{E}[s])\right)+1+\sigma-\bar{x}\right)}, 0\right\}. \quad (28)$$

An equilibrium is characterized by a fixed point of $\bar{\Delta}(\mathrm{E}[s])$, i.e., a schooling level s that satisfies $s = \bar{\Delta}(s)$, so that the schooling quality s that is expected by the parents is identical to the one actually implemented in the political process. Given $\Psi(\mathrm{E}[s])$ and the properties of (16) stated in the text, $\bar{\Delta}$ is a continuous function mapping the closed interval given in (26) into itself. Due to the Brouwer fixed point theorem, at least one equilibrium exists. Also notice that $\Psi = 0$ is always an equilibrium, since $\bar{\Delta}(\mathrm{E}[0]) = 0$.

Now assume that conditions $\gamma < \hat{\gamma}$ and $\sigma < \hat{\sigma}$ are satisfied. We want to establish that in this case pure public schooling $\Psi = 1$ is an equilibrium. In (28), the schooling quality corresponding to $\Psi = 1$ is $s = \eta\phi/(1+\gamma\eta)$. The first term inside the minimization in (27) satisfies for this s:

$$\begin{aligned}\frac{1-\eta}{2\sigma\delta\phi\eta}\, s - \frac{1-\sigma}{2\sigma} &= \frac{1-\eta}{2\sigma\delta(1+\gamma\eta)} - \frac{1-\sigma}{2\sigma} \\ &\geq \frac{1}{2\left(\frac{1-\eta}{\delta(1+\gamma\eta)}-1\right)}\left(\frac{1-\eta}{\delta(1+\gamma\eta)} - \left(2 - \frac{1-\eta}{(1+\gamma\eta)\delta}\right)\right) \\ &= \frac{1}{\frac{1-\eta}{\delta(1+\gamma\eta)}-1}\left(\frac{1-\eta}{\delta(1+\gamma\eta)} - 1\right) = 1,\end{aligned}$$

where $\gamma < \hat{\gamma}$ guarantees that the right-hand side of the first equation is positive, and the inequality follows from $\sigma \leq \hat{\sigma}$. The public education education quality $s = \eta\phi/(1+\gamma\eta)$ is therefore mapped into $\Psi(s) = 1$, which, in turn, implies $\Psi(s) = s$. Therefore, if pure public schooling is an equilibrium under an equal division of political power, it is still an equilibrium with a voting threshold $\bar{x} < 1-\sigma$. Since pure private schooling is always an equilibrium, we have at least two equilibria in this case. Next, notice that the slope of $\bar{\Delta}(s)$ is zero at $s = 0$, since for sufficiently small s we still have $\Psi = 0$. Also, at $s = \eta\phi/(1+\gamma\eta)$ the slope of $\bar{\Delta}(s)$ is zero as well, since given $\sigma < \hat{\sigma}$ we have $\Psi = 1$ in a neighborhood of $s = \eta\phi/(1+\gamma\eta)$. Given that $\bar{\Delta}(s)$ is continuous, it has to cross the 45-degree line at least one more time in between those values, implying the existence of a third equilibrium, which features segregation. ■

Proof of Proposition 5: We have established previously that:

$$\max\left\{\frac{\eta\phi}{\frac{(1+\sigma-\bar{x})\Psi}{(1-\sigma-\bar{x}+2\sigma\Psi)}+\gamma\eta\Psi},0\right\}\leq\frac{\eta\phi}{1+\gamma\eta\Psi},$$

where the left-hand side is the schooling level that arises for a given Ψ as a given by (16), and the right-hand side is the level that arises with equal political power as given by (11). Since the reverse mapping from a given schooling quality into Ψ does not depend on the distribution of political power, this inequality implies that the mappings Δ and $\bar{\Delta}$ defined in the proofs of Propositions 1 and 4 satisfy $\bar{\Delta}(s)\leq\Delta(s)$. Equilibria in the two environments corresponds to levels of s that satisfy $s=\bar{\Delta}(s)$ and $s=\Delta(s)$, respectively. It was established in the proof of Proposition 1 that $\Delta(s)$ is weakly decreasing and crosses the 45-degree line only once from above. Since $\bar{\Delta}(s)\leq\Delta(s)$, it then follows that $\bar{\Delta}$ cannot cross the 45-degree line above the unique crossing point for $\Delta(s)$, so that we have $\bar{s}\leq s$. Finally, the relationship between s and v does not depend on the distribution of political power, and taxes are monotonically increasing in s, so that we have $\bar{v}\leq v$. ■

B PISA Data: Education, Fertility, and Social Status

Country	Social status	Number of observations	Subsidization rate	Percent in private schools	Fertility
Australia	16-35	939	76.95	NA	3.30
	36-53	1777	72.33	NA	3.05
	54-70	1607	65.04	NA	2.94
	71-90	542	58.77	NA	2.83
Austria	16-35	874	95.52	4.46	2.81
	36-53	2213	91.60	9.26	2.58
	54-70	992	86.19	16.23	2.40
	71-90	276	80.62	26.09	2.63
Belgium	16-35	1558	89.21	68.87	3.01
	36-53	2388	88.08	75.63	2.59
	54-70	1573	85.46	81.25	2.66
	71-90	516	84.76	83.33	2.75
Brazil	16-35	1699	87.93	2.35	3.67
	36-53	831	79.52	10.59	3.36
	54-70	926	66.77	23.00	3.07
	71-90	125	41.60	49.60	2.86
Canada	16-35	6502	90.36	0.00	3.07
	36-53	9536	89.94	0.00	2.84
	54-70	9006	87.83	0.00	2.81
	71-90	2302	85.12	0.00	2.86
Czech Republic	16-35	1064	93.07	7.33	2.81
	36-53	2741	94.06	6.20	2.48
	54-70	1141	94.71	6.22	2.32
	71-90	309	95.25	6.47	2.19
Denmark	16-35	883	95.11	20.50	3.05
	36-53	1445	94.75	23.18	2.81
	54-70	1130	94.42	24.78	2.88
	71-90	271	94.50	25.46	2.87
Finland	16-35	1010	99.84	1.58	3.26
	36-53	1911	99.85	3.30	2.94
	54-70	1453	99.83	3.51	2.86
	71-90	381	99.78	4.72	2.88
France	16-35	1191	78.29	22.50	3.14
	36-53	1443	75.57	21.83	2.62
	54-70	929	73.36	20.67	2.61
	71-90	268	69.29	26.12	2.89

Country	Social status	Number of observations	Subsidization rate	Percent in private schools	Fertility
Germany	16-35	887	97.89	2.03	2.77
	36-53	1970	97.84	3.40	2.46
	54-70	1105	96.56	6.52	2.38
	71-90	357	96.11	7.84	2.46
Greece	16-35	1278	85.63	1.10	2.68
	36-53	1447	87.02	2.07	2.44
	54-70	1074	82.60	4.38	2.31
	71-90	280	72.52	15.71	2.24
Hungary	16-35	1022	85.76	3.82	2.74
	36-53	2070	86.68	4.01	2.42
	54-70	1281	88.20	3.51	2.30
	71-90	261	90.18	6.13	2.38
Iceland	16-35	572	99.58	0.00	3.80
	36-53	1300	99.52	0.62	3.46
	54-70	926	99.10	1.30	3.37
	71-90	364	98.82	1.92	3.46
Ireland	16-35	990	94.68	50.71	3.94
	36-53	1463	91.43	63.98	3.52
	54-70	1040	87.83	72.21	3.33
	71-90	183	81.23	78.69	3.25
Italy	16-35	1391	79.47	2.16	2.45
	36-53	1995	74.50	5.81	2.30
	54-70	896	74.53	5.80	2.22
	71-90	281	71.17	6.05	2.34
Korea	16-35	1554	53.63	47.23	2.46
	36-53	1840	48.12	50.00	2.25
	54-70	803	46.47	49.69	2.18
	71-90	96	42.19	45.83	2.20
Mexico	16-35	1607	44.74	3.17	4.33
	36-53	1134	40.15	17.20	3.74
	54-70	619	34.52	33.60	3.39
	71-90	222	29.87	49.55	2.95
Netherlands	16-35	480	94.93	72.92	3.09
	36-53	739	94.59	77.00	2.80
	54-70	807	93.86	76.70	2.79
	71-90	153	94.85	71.90	2.86

Country	Social status	Number of observations	Subsidization rate	Percent in private schools	Fertility
New Zealand	16-35	643	84.82	0.78	3.56
	36-53	1275	81.16	3.61	3.20
	54-70	1041	78.20	5.86	3.07
	71-90	339	73.19	12.39	2.86
Norway	16-35	418	99.57	0.72	3.40
	36-53	1737	99.71	0.63	2.98
	54-70	1148	99.53	1.13	2.99
	71-90	538	99.39	1.12	2.95
Poland	16-35	1052	94.78	0.38	3.07
	36-53	1449	92.08	2.00	2.75
	54-70	564	91.24	4.08	2.49
	71-90	156	82.51	13.46	2.45
Portugal	16-35	1843	89.10	7.27	2.67
	36-53	1501	86.67	6.46	2.33
	54-70	747	83.58	8.17	2.23
	71-90	278	77.73	7.55	2.28
Russia	16-35	1594	94.19	0.00	2.91
	36-53	2742	93.38	0.00	2.71
	54-70	1135	92.94	0.00	2.66
	71-90	828	94.15	0.00	2.44
Spain	16-35	2078	90.92	24.01	2.60
	36-53	2020	82.93	42.48	2.36
	54-70	902	73.21	55.21	2.40
	71-90	387	59.13	68.22	2.50
Switzerland	16-35	1290	98.28	2.56	2.93
	36-53	2398	96.20	5.50	2.58
	54-70	1351	93.73	8.44	2.54
	71-90	582	89.72	13.40	2.68
United Kingdom	16-35	1858	98.24	0.65	3.44
	36-53	3166	96.50	2.46	2.99
	54-70	2276	89.99	8.92	2.82
	71-90	856	84.93	14.02	2.82
United States	16-35	584	94.01	4.11	3.80
	36-53	840	92.42	5.12	3.54
	54-70	899	92.84	5.01	3.10
	71-90	202	87.18	7.92	3.02