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# Human Capital Investment and Globalization in Extortionary States

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ABSTRACT

**Human Capital Investment and Globalization in Extortionary States**

by Fredrik Andersson and Kai A. Konrad*

This paper considers education investment and public education policy in closed and open economies with an extortionary government. The extortionary government in a closed economy chooses an education policy in order to overcome a hold-up problem of time-consistent taxation similar to benevolent governments. The two types of government differ in their education policies if highly productive labor is mobile. Extortionary governments' incentives for a policy that stimulates higher private education efforts vanish; instead they have incentives to prevent individuals from mobility-increasing education investment. Tax competition therefore reduces hold-up problems of time-consistent extortionary taxation, but introduces other distortions that reduce workers' utility.

*Keywords: Migration, education, globalization, commitment, time consistent income taxation*
*JEL classification: H21, H23*

ZUSAMMENFASSUNG

**Humankapitalinvestitionen und Globalisierung in Ausbeutungsstaaten**

In der Arbeit untersuchen wir private und öffentliche Humankapitalinvestitionsentscheidungen in geschlossenen und offenen Volkswirtschaften. Wir unterstellen für die Analyse eine stark eigennutzorientierte Regierung, die versucht, die Nettosteuereinnahmen zu maximieren und diese Einnahmen für Zwecke verausgabt, die nicht den Nutzen der Staatsbürger mehren. Es zeigt sich, dass auch eine solche Regierung in einer geschlossenen Volkswirtschaft öffentliche Bildungsinvestitionen tätigt bzw. private Bildungsinvestitionen subventioniert, weil sie damit ein Problem mangelnder staatlicher Selbstbindung löst. Wir betrachten dann offene Volkswirtschaften, in denen die gutausgebildeten und produktiven Individuen international mobil sind. In der resultierenden Steuerwettbewerbssituation verzichten eigennutzorientierte Regierungen auf öffentliche Bildungsinvestitionen und Bildungssubventionen und versuchen unter Umständen sogar, private Bildungsinvestitionen zu behindern.

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# 1 Introduction

The transaction costs of migration are declining in Europe. Migration obstacles within the EU, for instance, have been abolished in several steps, with the biggest step made in 1992 when the common market that granted free mobility for factors was introduced. The resulting increase in mobility is discussed and documented in, for example, Wildasin (2000). In addition, the further EU enlargement that opens up the labor markets between the current members of the EU and the countries currently applying for membership, as well as other global trends, will further increase labor mobility in the first decade of the new century. In this paper we consider the impact of increased mobility for education policy and the taxation of returns from human capital investment.

The starting point of this paper is the well established insight that optimal education policy and taxation of human capital income are closely related. Human capital investment suffers from a severe hold-up problem. The optimal time consistent tax on the returns from human capital investment is high at the time when education investment decisions are already made. This high tax is anticipated by individuals at the stage when they make their investment choices, and this reduces their incentives to invest.[1] Boadway, Marceau and Marchand (1996) analyze this problem and show that mandatory education or, similarly, subsidized provision of public education is a natural solution to this problem.[2] Hence, public provision of education

[1]Kydland and Prescott (1980) were among the first to analyse time consistent taxation of investment returns and the hold-up problem it generates in the context of capital income taxation.

[2]Indeed, this instrument is widely used in many OECD countries. Public investment in schooling and higher education is considerable. The mean of public expenditure on educational institutions among OECD countries was 5.3 percent of GDP in 1998 (OECD 2001a, p. 100) and this amount exceeds private expenditure on educational institutions by several hundred percent. While public subsidies to education as a second-best tool may be important for all levels of education, there are important additional aspects justifying public intervention, particularly for primary and secondary education. Total expenditure on tertiary education are also considerable, averaging 1.59 percent of GDP in the OECD

is a second-best policy. It is chosen as a remedy for the detrimental welfare effects of time consistent human capital income taxation in a closed economy.[3] While Boadway, Marceau and Marchand (1996) consider benevolent governments, it is clear that benevolent governments as well as kleptocrat or Leviathan governments face the same hold-up problem when it comes to the taxation of human capital returns; hence, their analysis carries over qualitatively to the Leviathan case.

Increased international mobility of skilled labor changes the set of constraints under which national policies are chosen. Taking the private investment problem and time consistent taxation as an isolated problem, it has been emphasized in the tax competition literature that the increased mobility of a tax base—such as highly skilled workers and their income—constrains the national governments in their ability to tax, because the individuals can avoid paying one country's taxes by moving to another country. Hence, international mobility of skilled labor changes the taxation problem, and may solve the hold-up problem of time consistent taxation. This was pointed out in the context of capital income taxation by Kehoe (1989) for the case of benevolent redistributive taxation. Other contributions have addressed the issue of education policy as an isolated problem disregarding the time consistency issue. For instance, Justman and Thisse (2000) start with the assumption that education must be provided publicly for exogenous reasons, and conclude that mobility of the highly skilled may necessitate harmonization or coordination between the countries' policies. In principle, this co-

countries in 1998, and the average share of public financing exceeds 80 percent if subsidies to households are included (OECD, 2001a, p. 81 and 94). Given the fact that human capital is, for most parts, a private good, this may be surprising. In addition, human capital returns are highly taxed. Maximum personal income tax rates of central government within the OECD averaged 54.2 percent in 1986, and ranged from 33 percent (New Zealand) to 66 percent (Belgium), with an OECD average of 50.2 percent in 1998 (OECD, 1989, 2001b).

[3] Gradstein (1998) has made a similar point regarding the role of public provision of education; Kanniainen and Poutvaara (2000) have explored how complementarities in production make subsidization of education desirable.

ordination could take place on the expenditure side (coordinated spending on public education), or on the revenue side (coordination of human capital taxes). These contributions disregard the important fact that public education provision and high income taxes are symptoms for a more fundamental time consistency problem, and that education policy is already a second-best policy that addresses an existing distortion: the hold-up problem due to time consistent taxation of human capital returns.

For a benevolent government that uses tax revenue to redistribute according to a welfarist objective, this connection is taken into account in the analysis of increased mobility by Andersson and Konrad (2000). As is shown there, full mobility of the skilled does not necessarily eliminate the incentives for public provision of education or education subsidies, and does not necessarily generate an allocation problem. On the contrary, full mobility may restore efficiency.

In this paper we consider tax policy and public provision of education for a Leviathan government, concentrating on the close link between taxation and education policy. We start with a closed economy that resembles the Leviathan models of government in Olson (1993) and McGuire and Olson (1996) but introduce the problem of time consistent taxation in this framework. We find that a Leviathan would like to overcome the hold-up problem of time consistent taxation by education subsidies. We show that this policy can benefit both the Leviathan and the people.

Our main results are on the impact of mobility of skilled labor. Having solved for the case with no international mobility by considering the closed economy, we compare this outcome with the case of full mobility, and with the intermediate case with finite but positive mobility cost. With full mobility, we show that the Leviathan fully abstains from any public provision of education or education subsidies. In fact, the Leviathan may restrict or eliminate private investment in education in this case. It is important to note that this outcome—i.e. full elimination of private investment—is inferior to the closed economy outcome both for the Leviathan and for the individuals. Depending on how the Leviathan can adjust the education policy to a switch from a closed economy to a globalized economy in which the highly skilled workers are mobile, the individuals' expected utility can be higher or lower in the globalized world compared with the closed economy case. In a static context with taxes being the only decision variables, the view is well established that increased international tax-base mobility benefits the population if the Leviathan does not spend the tax revenue on activities that benefit the population. Our result shows that the outcome can be different in a dynamic context. If Leviathans can distort an investment decision that affects mobility, they still dislike tax competition, but tax competition between Leviathans need no longer be beneficial for the people; this is true even if the Leviathan fully appropriates all tax revenues for personal use.[4]

We also solve for the tax competition equilibria if the highly skilled workers have finite but strictly positive migration costs. We find that the expected tax revenues in the equilibrium exceed the sum of migration cost that would occur if every highly skilled worker moves to another country.

In the next section we set out the model, and in section 3 we consider the closed economy case. In section 4, we consider a globalized world, and in section 5 we conclude.

## 2 The model

Consider the following two-period model that adopts Olson's (1993) investment problem of a Leviathan but accounts for the hold-up problem in taxation considered in the context of benevolent governments as in Boadway, Marceau and Marchand (1996), Konrad (2001) and Andersson and Konrad (2000).[5] There are two identical countries $A$ and $B$, each with a continuum

[4] Edwards and Keen (1996), for instance, show that tax competition in a static framework is less likely to be in the interest of the population the smaller the share of the tax revenue that is spent on goods which are valued by the population. There is no contradiction between our results and Edwards and Keen (1996) as we simply highlight an additional dimension of the problem.

[5] It is straightforward to endogenize labor supply in this model, or to extend this model and its equilibrium results to an overlapping generations model with an infinite horizon.

$[0, 1]$ of individuals. Individuals live for two periods. In period 1 all individuals are identical. Each makes a private investment in education. The amount of effort invested by individual $i$ is $e$. (Here and in what follows we skip subscripts that denote individuals.) Individuals earn labor income in period 2. They differ in their productivity. The productivity of each individual is determined (by nature) at the beginning of period 2. Individual $i$'s probability of becoming highly productive is $p(e)$. Earnings are $m_H$ or $m_L < m_H$, if the individual ends up with High or Low productivity respectively. Individual $i$'s investment $e$ in period 1 increases the probability of the individual becoming highly productive. If no educational investment is made, the individual will have low productivity with probability one in period 2. The probability $p(e)$ is assumed to be a monotonically increasing function in educational investment. More specifically, $p(0) = 0$, $\lim_{e \to 0} p'(e) = \infty$, $p'(e) > 0$, $p''(e) < 0$, and $\lim_{e \to \infty} p(e) < 1$.[6] We further assume that the individual productivity outcomes for all individuals are mutually stochastically independent.

The government can change the individual cost of investment in education. Let $(1 - s)e$ be the individual cost of education investment $e$, with $s$ the government's education policy, which is a choice variable that will be discussed below. An individual's utility will be described by

$$U = -(1 - s)e + \nu(e) + (1 - p(e))u(x_L) + p(e)u(x_H), \tag{1}$$

where $x_L$ and $x_H$ are the individual's incomes if the educational investment is not/is successful. Education cost $(1 - s)e$ enters utility as a cost in period 1. Education investment $e$ enters in this cost term in (1) linearly by normalization. The function $\nu(e)$ is assumed to be increasing and strictly concave and measures the consumption benefit from education in period 2, with $\nu(0) = 0$. In order to avoid corner solutions, we assume that the first unit of education has sufficiently high private consumption benefit: $\lim_{e \to 0} \nu'(e) = \infty$.

In the infinitely repeated game additional (cooperative) equilibria could emerge and (partially) overcome the hold-up problem. However, this aspect is not analysed here.

[6] The two-type assumption is for simplicity and has been made in the optimal tax literature, e.g., by Stern (1982), Stiglitz (1982) and, in a context related to this one, by Boadway and Marchand (1995).

Net income $x$ enters utility positively: the utility-of-income function $u$ is monotonically increasing and concave. Government's education policy affects individual cost of investment. For instance, the government may provide facilities such as public libraries that are complementary with private education effort, in which case $s > 0$, or restrict access to such goods, in which case $s < 0$. The government has some cost of choosing $s \neq 0$. The cost of implementing a particular $s$ is denoted $C(s)$, and we assume that this function is U-shaped, with $C(0) = 0$.[7] The marginal cost of extreme policies are assumed to be high, that is, $\lim_{s \to 1} C'(s) = +\infty$ and $\lim_{s \to \underline{s}} C'(s) = -\infty$ for some $\underline{s} < 0$ . That is, it becomes prohibitively costly for the government to reduce private unit cost of education to zero, or to increase it to infinity. Finally, we assume that the Leviathans are not constrained with respect to their expenditure by future revenues; that is, their desired education policy can always be financed.[8]

# 3 The closed economy

Consider first a situation in which migration is ruled out, for instance because the cost of migration is extremely high. We will characterize the laissez-faire outcome as a benchmark case, and then study a Leviathan government.

[7] We could also think of subsidies or taxes on goods that are complementary with private education investment. The cost then becomes a function not only of the country's own $s$, but also of actual investment choices, which, in turn, depend on expected income taxes, and, hence, potentially on other countries' education policies. While the basic argument is not affected by such a complication, the formal analysis becomes more involved.

[8] This assumption is for simplicity, as losses will not occur in the equilibrium. But due to this assumption we can treat the Leviathan as a firm that maximizes profit, not having to take a budget constraint into consideration, which could limit the set of feasible strategies.

## 3.1 The laissez-faire equilibrium

Suppose there is no government that could impose taxes and subsidize education. Individuals choose education $e$. Also, much in line with the literature (see, e.g., Eaton and Rosen 1980, Varian 1980, and Sinn 1996), we assume that private insurance markets do not exist.[9] Individuals maximize their expected utility, which leads to the first-order condition

$$\nu'(e) + p'(e)[u(m_H) - u(m_L)] = 1 \tag{2}$$

characterizing the equilibrium human capital investment.

## 3.2 The Leviathan equilibrium

Consider now a (kleptocrat) Leviathan government that maximizes tax revenue net of its expenditure on education policy. This revenue is not refunded to the population in terms of public goods or transfers, but is used for purposes that benefit only the Leviathan. Assuming for simplicity that the interest rate is zero for the Leviathan and for all individuals, the Leviathan's payoff is the sum of taxes in period 2 minus the cost of the education policy in period 1. The Leviathan and the individuals are players in a 4-stage game. In stage 1 the Leviathan chooses per-unit education cost by its education policy $s$. In stage 2 individuals choose their human capital investments $e$. In stage 3 nature determines whether an individual will have high or low productivity, as described in section 2. Finally, in stage 4, the Leviathan chooses income taxes.

The Leviathan can observe individual incomes (that is, productivity types) and is constrained to appropriate only the share of income that exceeds some

[9] The most compelling justification for this assumption has been given by Sinn (1996): when individuals make major human capital investment decisions, they are often too young to be allowed to participate in business life and write insurance contracts. The assumption about availability of private insurance is important for the results, as has been seen in Andersson and Konrad (2000).

minimum income $m_{\min}$, with $m_{\min} < m_L$.[10] Time consistent behavior implies that the Leviathan confiscates all income that exceeds $m_{\min}$. This solves stage 4 of the game.

Individuals anticipate this time consistent behavior of a Leviathan when they determine their optimal human capital investment in stage 2. They maximize (1), and anticipate that $x_H = x_L = m_{\min}$. The first-order condition that determines their equilibrium choice of education investment for given subsidies is[11]

$$\nu'(e) = 1 - s. \tag{3}$$

Condition (3) implicitly determines private education investment as a function $e(s)$ of the education policy $e$, and also the equilibrium shares of productivity types $p^*(s)$ as a function of unit cost $(1-s)$, where $p^*(s)$ is an increasing function of $s$ by (3). Further, $p^*(s)$ is assumed to be concave[12], in order for the Leviathan's first-order condition to determine a unique equilibrium. Hence, for a given education policy, the education effort is inefficiently low. As the consumption motive $\nu(e)$ is the same both in the laissez-faire and with a Leviathan, a strong consumption motive increases the amount of investment in (3) and the efficient amount of investment, but cannot compensate for the externality that is introduced by the taxation of the returns from investment. If the consumption motive was absent, there would be zero investment in education independently of the education policy. Education policy would be effective, however, if the Leviathan could not appropriate the full return on education investment, which may be true because of information problems. For instance, if the net income of individuals in an

[10] In a full information context, it would not be natural to restrict the Leviathan to use a proportional tax, and type-dependent flat taxes are the Leviathan's most efficient instruments. Of course, incomplete information may require that different productivity types earn different information rents. But this is a different aspect that is tangential to the issues we are focusing on here.

[11] To guarantee an interior solution, we make use of the assumption that the first marginal unit of education yields sufficiently high consumption benefit. If this assumption is not made, a corner solution with $e = 0$ may prevail.

[12] For this to be true, some joint restrictions on $p(e)$ and $\nu(e)$ have to be imposed.

extortionary state is an increasing function of their gross income, an education policy will to some extent be effective, even without a consumption motive.

In stage 1 the Leviathan chooses education subsidies in order to maximize $p^*(s)(m_H - m_{\min}) + (1 - p^*(s))(m_L - m_{\min}) - C(s)$, which can be rewritten as

$$p^*(s)(m_H - m_L) + (m_L - m_{\min}) - C(s). \tag{4}$$

The marginal condition determining the public education policy is

$$\frac{dp^*(s)}{ds}(m_H - m_L) = C'(s). \tag{5}$$

Note that the left-hand side in (5) is positive. Hence we find:

**Proposition 1** *In a closed economy with time consistent income taxation the Leviathan has an incentive to reduce private cost of education investment.*

This proposition parallels the results on education subsidies in a closed economy with a utilitarian government and time consistent taxation, as in Boadway, Marceau and Marchand (1996). Leviathans and utilitarian governments have similar incentives to remedy the problem of time consistent income taxation by education policy.

An interesting aspect of this policy here is that, although it does not increase individuals' net of tax income in the equilibrium, the Leviathan's education policy benefits the individuals because it increases their rent from education consumption.

# 4 A globalized world

Language barriers, asymmetric information as regards local customs, laws and regulation, and partially incompatible, or at least incompletely harmonized, social security provisions still generate considerable migration cost for those who consider moving from one country to another. However, there is a clear trend by which migration cost is being reduced, due to economic and political integration. Education can be expected to make individuals more mobile. For instance, language skills help overcoming language barriers. To emphasize this general trend, we assume in this section that skilled workers are mobile, whereas unskilled workers are perfectly immobile. The situation in which individuals with high productivity have uniform migration cost equal to zero will be a particularly interesting benchmark case[13] that can be compared with the equilibrium in a closed economy. After exploring this case, we will solve for the equilibria with positive but finite migration cost.

Note first that, given the assumed symmetry, the laissez-faire outcome does not change if migration is feasible. Individuals' income in the laissez-faire depends only on their productivity and it is the same in both countries, whether they migrate or not.

Consider now the situation with two Leviathan governments in two countries, $A$ and $B$, in a globalized world. The game structure is as follows. In period 1, in stage 1, the governments in both countries choose their education policies $s^A$ and $s^B$. In stage 2 individuals choose their education effort. In stage 3, nature reveals each individual's productivity type; that is, individual earnings in period 2. In stage 4, at the end of period 1, the Leviathans choose taxes. In stage 5 (period 2), low-skilled individuals are immobile and stay in the country of their origin. High-skilled individuals find out about their actual cost of migration. This cost is $c$ and drawn independently for each individual from a probability distribution with support $[0, M]$.[14,15] Finally,

[13] This assumption is, for instance, also pursued in Poutvaara (1999) who considers labor tax competition when taxes are used for redistribution. He assumes, however, that the government can fully commit itself to an ex-ante optimal tax policy.

[14] Migration cost are determined after governments have chosen their taxes for simplicity. We are very grateful to a referee for making this suggestion.

[15] In order to concentrate on the education investment incentives, we assume constant returns technologies, with $m_H$ and $m_L$ the physical products of the two productivity types. This is a simplification, because migration changes the relative scarcity of skilled and unskilled labor, and, depending on the production functions, mobility of other factors, trade restrictions etc., migration may have a number of, partially offsetting, effects. However, for each of these effects a straighforward analysis could be carried out showing how this effect counteracts or reinforces the mechanisms that are under consideration in this paper.

the highly productive and mobile individuals choose whether to stay or to migrate to the other country. Mobile individuals who are born in country $A$ can stay in this country and earn $m_H - t_H^A$, or they move to country $B$ and receive net income $m_H - t_H^B - c$, where $c$ is the cost of migrating, and similarly for individuals who are born in country $B$.

For the explicit solution of the tax competition game and of stages 2 and 1 of the game, we distinguish two cases. We consider first the case with zero migration cost ($M = 0$) and then move to the more general case.

## 4.1 Zero migration cost

Suppose that the cost of migrating from one country to another is zero; i.e., $M = 0$, and hence, $c \equiv 0$. In this case the tax-competition game is a Bertrand game, and as individuals are identical with respect to all unobservable characteristics the unique Nash equilibrium is $t_H^A = t_H^B = 0$, and $t_L^A = t_L^B = m_L - m_{\min}$. In stage 2 individuals anticipate that they pay a tax equal to $t_L^A = t_L^B = m_L - m_{\min}$, if they find out that they have low productivity and are immobile, and that they will not pay any taxes if they become productive in stage 3. Accordingly, their incentives to invest in education for given education subsidies are described by the first-order condition

$$\nu'(e^i) + p'(e^i)(u(m_H) - u(m_{\min})) = 1 - s^i. \tag{6}$$

Condition (6) determines the share of highly productive individuals in country $i$ (prior to possible migration) as a function $p^i(s^i)$ of the education policy $s^i$. A closer look at (6) reveals that individuals' incentives for human capital investment in a state that is ruled by a Leviathan strictly exceed their investment incentives in the laissez faire when high productivity goes along with high mobility: the left-hand side in (6) exceeds the left-hand side in (2). Intuitively, individuals can escape from confiscatory taxation if they become highly skilled, whereas low-skilled workers are taxed. The benefit of becoming highly skilled is larger in a globalized world with Leviathan governments than in closed economies with a Leviathan, and even larger than in the absence of confiscatory taxation. Hence, for given education policy $s$, education investment in a globalized economy with a Leviathan is excessive from an efficiency point of view.

Consider finally stage 1. In order to characterize a unique equilibrium by the first-order condition, we require that $p^i(s^i)$ is concave. The Leviathan's payoff in country $i$ is

$$(1 - p^i(s^i))(m_L - m_{\min}) - C(s^i) \tag{7}$$

and, using the fact that each country's tax policy in stage 3 is independent of the other country's education policy here, the first-order condition for a maximum is

$$-\frac{dp^i(s^i)}{ds^i}(m_L - m_{\min}) = C'(s^i). \tag{8}$$

Given that the left-hand side of equation (8) is non-negative, and typically positive, this implies that the Leviathan chooses an education policy at which the *marginal cost of an increase in* $s^i$ *is negative.* That is, the Leviathan is willing to incur positive marginal cost for increasing the unit cost of education in his country. The Leviathan is willing to spend resources to discourage individuals from education investment. The resulting choice of education policy yields a unit cost of education that exceeds the unit cost in the laissez faire.

Intuitively, the Leviathan knows that highly productive and mobile individuals will not pay taxes, this being in contrast to immobile individuals with low productivity. Hence, the Leviathan would like to tax education effort—or spend resources to prevent individuals from acquiring education. Note further that, if the $s$ that solves (8) is sufficiently close to zero, then education effort in the equilibrium with a Leviathan that is determined by (6) is higher than in the laissez-faire as determined by (2).

We summarize these results as

**Proposition 2** *Consider two countries with Leviathan governments. Suppose highly productive individuals are perfectly mobile and individuals with low productivity are perfectly immobile. (i) In the equilibrium the Leviathan has an incentive to restrict or to prohibit education, even if it is costly to* *the Leviathan to impose such restrictions. (ii) Private investment in education exceeds (falls short of) the laissez-faire equilibrium investment if the Leviathan's cost of education restricting policies is sufficiently high (low).*

The fact that the government would like to spend resources in order to prevent individuals from obtaining education is of particular interest. If taxation or prohibition of education is possible, the efficiency properties of the resulting equilibrium are very poor. Suppose, for instance, that the Leviathan can prohibit education at no cost (i.e., $\lim_{s^i \to -\infty} C(s^i) = 0$). Then education $e = 0$ in the equilibrium. All individuals have low incomes and remain immobile and end up with utility $U_i = u(m_{\min})$ which is less than their expected utility in the closed economy. Also the Leviathan is worse-off than in the closed economy in this case. Moreover, if education prohibition is not costless or not feasible, but taxation of education effort is feasible, the government may divert its efforts to extract revenue from individuals from income tax policy to education tax policy.

Albeit simple, this observation is an important caveat against the conclusion—put forward, for instance, by Brennan and Buchanan (1980)—that tax competition between Leviathan governments is unambiguously a good thing since it prevents governments from over-taxing individuals. Tax competition may divert the attention of the Leviathan to more costly means of extortion.

Leviathan-like governments have pursued policies to reduce mobility in the past. In modern times passports are mainly considered a requirement for entering other countries, but in former times, and up to recently in some socialist countries, refusal to issue a passport and border controls on exit were important instruments for restricting mobility. Similarly, up to the first half of the nineteenth century, landlords imposed severe mobility restrictions on their peasants in many countries in Europe. Many of these mobility barriers cannot be sustained in modern times, however, and an important instrument by which governments can influence mobility is education policy, because high skills supposedly make individuals mobile. The way in which language skills were strongly discouraged in the Soviet Union and among its allies seems to be an instance where such a policy was observable.

## 4.2 Tax competition with finite moving costs

We consider now the case in which workers with low productivity are still immobile, whereas workers with high productivity are mobile and face positive migration cost. Generally, the solution and the existence of a tax-competition equilibrium in pure strategies will depend on the probability distribution of migration cost. We consider migration costs that are uniformly distributed on an interval $[0, M]$, with the highest possible migration cost smaller than the maximum tax that can be imposed on highly productive workers, that is, $M < m_H - m_{\min}$.[16]

In stage 5, if individuals receive the same income net of taxes and migration cost whether they migrate or not, we assume that they stay in their country of origin. Accordingly, the number of highly skilled individuals in country $A$ is

$$\gamma^A(t_H^A, t_H^B) = \begin{cases} p(e^A) \cdot \max\{(1 - \frac{1}{M}(t_H^A - t_H^B)), 0\} & \text{if } \ t_H^A - t_H^B > 0 \\ p(e^A) & \text{if } \ t_H^A - t_H^B = 0 \\ p(e^A) + p(e^B) \cdot \min\{\frac{1}{M}(t_H^B - t_H^A), 1\} & \text{if } \ t_H^A - t_H^B < 0 \end{cases} ; \tag{9}$$

and $\gamma^B$ is obtained by replacing all superscripts $A$ by $B$ and vice versa.

In stage 4 the Leviathan in country $A$ maximizes

$$t_L^A(1 - p(e^A)) + t_H^A \gamma^A \tag{10}$$

subject to $t_L^A \in [0, m_L - m_{\min}]$ and $t_H^A \in [0, m_H - m_{\min}]$, and (9) for given tax rates $t_H^B$ and $t_L^B$. The optimal choice of the tax for immobile individuals is $t_L^A = m_L - m_{\min}$ independently of taxes in country B. However, the taxes on the group of highly mobile individuals in the two countries are determined in a Nash equilibrium. Concentrating on symmetric equilibria in which individuals anticipated that highly productive individuals will face the same tax rates in both countries, and made identical education efforts, this (unique) equilibrium is determined by

$$t_H^A = t_H^B = M;$$

[16]This assumption follows a suggestion made by a referee for which we are very grateful.

this follows directly from inspection of the reaction functions that are provided in the Appendix.

These equilibrium tax rates can be used to solve for the individuals' investment incentives. Individuals do not know their individual cost of migration if they become highly productive. However, given that both countries charge the same tax to highly productive individuals, no individual will move. The marginal conditions that determine investment incentives for given (and symmetric) education policies $s^i$ in the equilibrium (in which individuals anticipate that $t_L^A = t_L^B = (m_L - m_{\min})$ and $t_H^A = t_H^B = M$) are therefore

$$\nu'(e^i) + p'(e^i)[u(m_H - M) - u(m_{\min})] = 1 - s^i.$$

This makes use of the fact that there is a continuum of individuals in each country—implying that each individual's education investment has no measurable impact on the share of highly productive individuals—so that individuals can perceive the equilibrium taxes as independent of their own individual education investment choice. The condition shows that, for a given education policy, education investment is a decreasing function of migration cost $M$. The higher is the migration cost, the higher the tax that has to be paid by highly productive individuals, and hence, the smaller is the individual's utility gain from becoming highly productive.

We summarize these results as

**Proposition 3** *Consider symmetric equilibria of the tax-competition game with moving cost $c$ uniformly distributed on $[0, M]$ with $M < m_H - m_{\min}$ . For given education policies $s^A = s^B$, the education investment is lower the higher is the migration cost (measured by $M$).*

The second determinant of education investment is education policy. The equilibrium education investment and, hence, the share of highly productive individuals in country $A$ is a function of education policies and taxes: $p^A(s^A, s^B; t^A, t^B)$, and similarly for country $B$. However, unlike in the case with zero migration cost, the choice of education policy is a more complex matter. The Leviathan's (reduced) payoff function is

$$(1 - p^i(s^i))(m_L - m_{\min}) + \gamma^i t_H^i - C(s^i),$$

where $t_H^i = M$ in the symmetric equilibrium. Note that, differently from the case with zero migration cost, the number $\gamma^i$ of individuals with high productivity that will be taxed in country $i$ enters into the payoff function. This share is generally a function of equilibrium tax rates. These tax rates depend on the shares $p^A$ and $p^B$ of highly productive individuals (as shown in the Appendix). These shares are functions of education investment choices, and these choices depend on expected tax rates and education policies. The first-order condition for an interior maximum is

$$-\frac{dp^i}{ds^i}(m_L - m_{\min}) + \frac{d(\gamma^i t_H^i)}{ds^i} = C'(s^i). \tag{11}$$

Comparing (8) and (11), we see that the imperfect mobility of skilled workers introduces an additional term—the second term on the left-hand side—compared with the case with zero migration cost. In addition, however, the derivative in the first term will contain an additional effect due to the tax rate in country $B$ depending on the education policy in country $A$, and vice versa.

One would expect that the second term on the left-hand side is positive, and that the equilibrium education subsidy is increasing in $M$. However, this is not straightforward, and there are several countervailing effects. First, with positive $M$, the individual incentives to invest are reduced for given education policy, because the expected savings in taxes that accrue from becoming highly productive and mobile are smaller. Second, a given education policy $s^i$ with given marginal cost can be more or less effective at the margin, due to the change in private investment incentives. Third, with positive $M$, the government can extract some taxes from highly skilled workers, and this makes a higher $s^i$ more attractive for the Leviathans. Fourth, education policy becomes more important as a strategic variable, as a change in one country's education policy changes both countries' equilibrium tax rates, and this anticipated change interacts further with individuals' incentives to invest in education. It does indeed seem likely that the equilibrium education policy is monotonically increasing in $M$. Due to the nexus of reactions alluded to—and their effects on both terms on the left-hand side of (11)—we have only been able to obtain a partial result which does not resolve the comparative statics.[17]

The most interesting aspects of these tax competition equilibria are that for given education effort, the Leviathans' expected tax revenues are strictly increasing in migration cost, and that the average tax revenue which is to be paid by highly skilled mobile individuals in the equilibrium exceeds what the Leviathan could obtain from charging a tax that simply equals the migration cost. In a previous version of the paper (Andersson and Konrad, 2001), we considered a case where all workers had the same (positive but non-prohibitive) moving cost, $c$. It turns out that the game between the countries does not have a pure-strategy equilibrium under such circumstances. In Andersson and Konrad (2001) a mixed-strategy equilibrium is characterized; the mixed-strategy equilibrium depends continuously on $c$ on the range between zero and the prohibitive level, but comparative statics on the equilibrium is generally ambiguous. A feature that is in line with the results from the current specification is that expected tax revenue when $c > 0$ exceeds the sum of moving cost that occurred if all high-skilled workers in a country moved.

# 5 Summary

In this paper we analyzed the equilibrium outcome on education policy, private education investment, and income taxation, both in a closed economy and in a globalized economy where the government is a Leviathan. As a starting point, the paper has acknowledged the close relationship between education policies and time consistent tax policy. In closed economies, the Leviathan acts in a way very similar to a benevolent welfare-maximizing government, leading to similar outcomes in terms of education policies as well as private education effort in the two cases. In the open economy context with

[17] A technical appendix with this result is available from the authors.

free mobility of highly productive labor, however, the two types of government exhibit very different behavior. As has been shown in Andersson and Konrad (2000), benevolent governments may still spend money on education policies. Leviathans do not. Leviathans will spend resources on making it more likely that individuals do not become highly skilled (and mobile); if costlessly possible, they would wish to prohibit education. As a result, mobility of the highly skilled and the induced tax competition reduces the Leviathan's utility. The individuals' utility may increase or decrease. Utility clearly increases if the Leviathan's education policy remains unchanged. If the Leviathan can discourage education effectively, however, the constraints introduced by mobility may reduce the equilibrium utility for Leviathans *and* for individuals. These results corroborate a more general conclusion, viz. that the competition among extortionary governments induced by increased mobility of factors is likely not only to bring beneficial tax competition, but also additional distortions that may be socially costly.

# Appendix

*Reaction functions with $M > 0$.*

In this appendix we derive the Leviathans' reaction functions $t_H^A(t_H^B)$ and $t_H^A(t_H^B)$ for given choices of $e^A$ and $e^B$ and show that the equilibrium occurs at $t_H^A = t_H^B = M$ if migration cost are uniformly distributed on the interval $[0, M]$ with $M < m_H - m_{\min}$. We consider first the Leviathan in country $A$. His objective function with respect to $t_H^A$ is

$$t_H^A \gamma^A = \begin{cases} t_H^A(p(e^A) + p(e^B)) & \text{for } \; t_H^A \leq t_H^B - M \\ t_H^A(p(e^A) + p(e^B)\frac{t_H^B - t_H^A}{M}) & \text{for } \; t_H^A \in [t_H^B - M, t_H^B] \\ t_H^A p(e^A)(1 - \frac{t_H^A - t_H^B}{M}) & \text{for } \; t_H^A \in [t_H^B, t_H^B + M] \\ 0 & \text{for } \; t_H^A \geq t_H^B + M \end{cases}$$

Accordingly, we find

$$\frac{d(t_H^A \gamma^A)}{dt_H^A} = \begin{cases} p(e^A) + p(e^B) & \text{for} \quad t_H^A < t_H^B - M \\ p(e^A) + p(e^B)\frac{t_H^B - 2t_H^A}{M} & \text{for} \quad t_H^A \in (t_H^B - M, t_H^B) \\ p(e^A)(1 - \frac{2t_H^A - t_H^B}{M}) & \text{for} \quad t_H^A \in (t_H^B, t_H^B + M) \\ 0 & \text{for} \quad t_H^A > t_H^B + M \end{cases}$$

$A$'s reaction curve for $e^A \geq e^B$ is given as

$$t_H^A(t_H^B) = \begin{cases} \frac{M}{2} + \frac{t_H^B}{2} & \text{for} & t_H^B \in [0, M) \\ t_H^B & \text{for} & t_H^B \in [M, M\frac{p(e^A)}{p(e^B)}) \\ \frac{M}{2}\frac{p(e^A)}{p(e^B)} + \frac{t_H^B}{2} & \text{for} & t_H^B \in [M\frac{p(e^A)}{p(e^B)}, 2M + M\frac{p(e^A)}{p(e^B)}) \\ t_H^B - M & \text{for} & t_H^B \geq 2M + M\frac{p(e^A)}{p(e^B)} \end{cases} \tag{A1}$$

and $A$'s reaction curve for $e^A \leq e^B$ is given as

$$t_H^A(t_H^B) = \begin{cases} \frac{M}{2} + \frac{t_H^B}{2} & \text{for} \quad t_H^B \in [0, M\frac{p(e^A)}{p(e^B)}] \\ \frac{M}{2}\frac{p(e^A)}{p(e^B)} + \frac{t_H^B}{2} & \text{for} \quad t_H^B \in (M\frac{p(e^A)}{p(e^B)}, 2M + M\frac{p(e^A)}{p(e^B)}) \\ t_H^B - M & \text{for} \quad t_H^B \geq 2M + M\frac{p(e^A)}{p(e^B)} \end{cases} \tag{A2}$$

The reaction function of the Leviathan in country $B$ is obtained from this by replacing all superscripts $A$ by $B$ and vice versa. These two reaction functions intersect, and, if they are symmetric, the intersection is at $t_H^A = t_H^B = M$.

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