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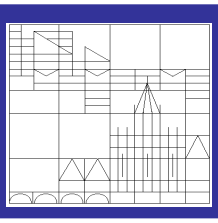

Public Education Spending in a Globalized World: Is there a Shift in Priorities Across Educational Stages?

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Public education spending in a globalized world: Is there a shift in priorities across educational stages?

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Abstract

This paper studies the effect of globalization on public expenditures allocated to different stages of education. First, we derive theoretically that globalization's influence on education expenditures depends on the type of government. For benevolent governments, the model suggests that expenditures for higher education will increase and expenditures for basic education will decline with deepening economic integration. For Leviathan governments, on the other hand, the effects of globalization on public education spending cannot be unambiguously predicted. In the second part of the paper, we empirically analyze globalization's influence on primary, secondary, and tertiary education expenditures with panel data covering 104 countries over the 1992 - 2006 period. The results indicate that globalization has led in both industrialized and developing countries to more spending for secondary and tertiary and to less spending for primary education.

Keywords: Globalization, economic integration, public education, education expenditures
JEL codes: F15, H42, H52

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1 Introduction

Globalization has received considerable attention in the political economy literature. One reason is that deliberate political actions such as trade liberalization and the abandonment of international capital controls have promoted the emergence of globalization.[1] An alternative explanation is that many studies dealing with the consequences of global economic integration examine how globalization has affected various domains of public policy. This includes especially the question whether a higher degree of global economic integration has changed the scope and limits of policy-making (Schulze and Ursprung, 1999).

From the public finance perspective, the literature highlights the implications of globalization for governments' ability to collect tax revenue. The main hypothesis investigated is whether the loss of governments' monopoly of coercion and strategic interactions with other governments competing for fiscal revenues has affected the design of tax systems (Aizenman and Jinjarak, 2009; Hines and Summers, 2009). In this context, one idea that suggests itself is whether taxes have shifted from mobile production factors such as capital to less mobile factors such as labor (Rodrik, 1997; Schwarz, 2007; Zodrow and Mieszkowski, 1986). Even though such investigations are enlightening, it should not be overlooked that labor, especially high-skilled labor, nowadays also more easily transcends national borders, albeit not as much as capital (Docquier and Marfouk, 2006; Egger and Radulescu, 2009; Grogger and Hanson, 2011). As a result, one may wonder whether governments have adjusted the composition of education expenditures in response to the threat of emigration of those who have received state-financed education.

Following such considerations, this paper investigates the effect of globalization on the composition of public education expenditures. We derive theoretically that readjustments of educational policies due to globalization are determined by the extent to which global economic integration affects (i) wages for different types of labor and (ii) mobility costs. By affecting wages and mobility costs, i. e. the "economic variables" in our model, globalization has an indirect effect on the fiscal policy of governments (tax rates and expenditures for different educational programs).

The model derives that the effect of globalization on public education expenditures depends on whether the government is benevolent or a Leviathan (i. e. a government that is only interested in maximizing tax rents). For example, let us assume that globalization increases the returns to high-skilled labor. The reaction of a benevolent government is straightforward: it will always seek to increase expenditures for higher education because this policy maximizes the aggregate income of its citizens. The reaction of a Leviathan government, on the other

[1] Note that the underlying driving force behind globalization are technological advances in transportation, communication, and the processing of information that are only weakly influenced by policy-makers (James, 2002). Cohen (1996) refers to political-driven versus technology-driven globalization as the "liberal" and "realist" models. In addition, he mentions two other perspectives emphasizing the role of the domestic political process and the importance of political culture and belief systems.

hand, is unpredictable. A Leviathan government has an incentive to increase expenditures for higher education because this policy would maximize the tax base (by maximizing aggregate income). Yet, individuals with a higher earnings potential (the product of education and returns to labor) are more likely to emigrate for fiscal reasons, thereby reducing the tax base. This consideration incentivizes the Leviathan government to reduce education expenditures for the high-skilled if returns for high-skilled labor increase (as this reduces their earnings potential). In general, it is unclear whether the incentives to increase or decrease education expenditures will prevail for a Leviathan government.

Due to such countervailing effects, the net influence of globalization on the government's educational priorities is essentially an empirical matter. We therefore confront our research question with data in the second part of the paper and conduct a dynamic panel analysis based on System GMM estimations for 104 countries over the 1992 - 2006 period.[2] An important challenge for the empirical analysis is to control for factors that might be correlated with both education expenditures and globalization. In particular, there is evidence that technological progress confers a wage-premium to high-skilled work, and this wage-premium might induce governments to increase spending for higher education (Bartel and Lichtenberg, 1987, 1991).[3] As technological change is presumably correlated with globalization, not controlling for it could result in biased estimates.

The estimation results reveal that globalization has induced governments in developed as well as developing countries to reduce spending for primary and increase spending for secondary and tertiary education. Most likely, students from socio-economically disadvantaged backgrounds benefit predominantly from primary education expenditures, while students with a wealthy background benefit more from higher education expenditures (Blanden and Machin, 2004; Hansen and Weisbrod, 1969). We therefore conclude that the effect of globalization on the composition of public education expenditures may widen the gap between rich and poor in the long-run.[4]

While the shift in educational priorities towards higher education reduces equity, the effect from an efficiency point of view is ambiguous. On the one hand, there is evidence that in developing countries the 'social rate of return' to public resources invested at the primary level is higher than for public expenditures on higher education levels (Carnoy, 1992; Lockheed

[2]In a previous version of our paper (Baskaran and Hessami, 2010), we used a slightly different set of control variables, which resulted in a panel with 121 countries. The smaller number of countries in this paper is due to the use of gross enrollment rates instead of the population shares of the age groups that are relevant for a particular type of education (primary, secondary, or tertiary) as the control for the "theoretical demand" for that type of education, and the inclusion of the number of internet users per 100 persons as a control for technological change. Despite these differences, the results and conclusions are similar.

[3]We are grateful to an anonymous referee for pointing this out.

[4]Wälde (2000) explains the negative relationship between the share of primary education expenditures and income inequality by deriving that a higher share of secondary and tertiary expenditures provides incentives for the development of technologies. These technologies in turn lead to a replacement of unskilled by skilled labor that gives rise to a higher extent of income inequality.

and Verspoor, 1991; Psacharopoulos, 1985).[5] This would suggest that the observed shift in educational priorities is inefficient. On the other hand, increased expenditures for higher education can be justified from an efficiency perspective by alluding to the fact that an increasingly technology-driven world characterized by fierce international competition requires more high-skilled labor.

The remainder of this paper is structured as follows. Section 2 reviews the existing literature on the linkages between globalization and education expenditures. Section 3 discusses the relationship between globalization and public expenditures for different educational stages in the context of a theoretical model. Section 4 describes the data and the empirical strategy, while the results of the empirical investigation are presented in section 5. Section 6 concludes the analysis.

2 Globalization and public education: a literature review

The implications of globalization for public education are studied in several social sciences, each of which emphasize different aspects of educational policies (Spring, 2008). For instance, the sociological and pedagogical literature primarily analyze whether globalization leads to a convergence of nationally diverse education systems (Green, 1999), whether it causes a "commodification"[6] of education (Naidoo and Jamieson, 2005), and whether international organizations increasingly affect the design of educational systems in developing countries (McNeely, 1995).

While the analysis of globalization's influence on different aspects of educational policies brings to light interesting insights, one has to acknowledge that educational policy has many dimensions. Hence, an analysis that is intended to examine the overall effect of globalization on educational policies needs to be based on a more aggregated measure. To this end, researchers usually resort to data for public spending on education. The impact of globalization on public education *expenditures* is primarily analyzed by economists and political scientists. The relevant theoretical contributions can be subdivided into two groups linking globalization with education expenditures through two distinct channels. The first strand of the literature is based on the tax competition perspective. In this view, globalization is understood to increase the mobility of the high-skilled, which impedes the government's ability to tax high-income earners. The reduction of the tax base has in turn an influence on public education expenditures.

[5]Note that Birdsall (1996) challenges the prevalent view that public resources for education in developing countries should be reallocated from higher to lower levels of education. Her main argument is that the available measures for social rates of returns to education do not capture all relevant dimensions.

[6]Education is generally regarded as a means for social development, democratic empowerment and the advancement of well-being and economic development of societies. The term "commodification" of education refers to the fact that education is increasingly understood as an economic factor, while students are looked upon primarily as consumers of education serving as human capital for the labor market.

One example for the tax competition approach is a study by Andersson and Konrad (2003b) that analyzes theoretically how globalization affects private education effort and public education policies under the assumption of a Leviathan government. In their model, governments can decrease the private costs of education by appropriate public policies (which can be understood as expenditures) and thus motivate individuals to acquire more education. More educated individuals earn a higher wage and thus provide a larger tax base, but they also emigrate more easily if the domestic tax rate is too high. The authors derive that, in general, it cannot be determined whether globalization induces governments to decrease the private costs of education suggesting no clear-cut link between globalization and total education expenditures.[7]

As the second contribution following the tax competition approach Haupt and Janeba (2009) assume that the government seeks to redistribute income from high- to low-skilled individuals by (which may seem paradoxical at first) providing the high-skilled with education subsidies. As a result, the future income of the high-skilled increases and this in turn causes the tax base to grow. The derivations suggest that globalization reduces public education subsidies since high-skilled individuals can emigrate more easily in a globalized world. This forces the government to lower the tax rate in equilibrium. To conclude, an increase in the tax base due to public education expenditures does not benefit the low-skilled as much as it does in a world with closed economies. Hence, the government reduces total education spending in an increasingly globalized world.

Poutvaara and Kanniainen (2000) arrive at a similar, albeit more extreme, conclusion by illustrating theoretically how costless mobility and international tax competition jeopardize the existence of the public education system. In the presence of positive externalities in education and complementarities in production of low- and high-skilled workers, it is derived that the low-skilled benefit indirectly from the education that the high-skilled receive. This leads to a voluntary social contract, which is implemented by means of a tax system through which both groups contribute to the financing of public education expenditures. When costless mobility is introduced in the model, the voluntary social contract breaks down due to high-skilled workers emigrating to low-tax countries after they have received their education and low-skilled workers free-riding on investments in education in other countries.[8] One possible solution to this dilemma is provided by Poutvaara (2001), where it is argued that the downward pressure on tax rates and public education spending can be mitigated by obliging the educated to pay taxes in the country where they have obtained their education.

Finally, Poutvaara (2008) provides an extension to the aforementioned studies by drawing a distinction between different subjects that are taught in higher education institutions. He

[7] Andersson and Konrad (2003a) further extend this paper and analyze the welfare implications of the availability of private insurance in a world with costless mobility of the highly-educated and risky investments in education.

[8] On the other hand, Poutvaara (2000) shows that tax competition may also encourage investment in education as mobility insures individuals against region-specific shocks to the returns to education.

argues that governments are aware of the increasing difficulty of taxation due to the threat of emigration. Therefore, governments react to globalization by reducing funding for fields of studies where the skills acquired are internationally transferable such as engineering. At the same time, governments provide more financial resources for subjects that are country-specific, such as law. This shift of education spending between different fields of studies is a valuable extension to previous investigations. However, due to the difficulty of obtaining data for such a detailed analysis, there is so far no empirical evidence in favor of this hypothesis.

The empirical evidence regarding globalization's effect on total education expenditures is mixed, which is not surprising given the disagreements in the theoretical literature. Dreher et al. (2008) find that globalization has not affected the share of education spending in total public expenditures. In contrast, according to Avelino et al. (2005) trade openness was positively related to education spending in Latin America during the 1980 - 1999 period. Shelton (2007) tests a large number of determinants of public education expenditures simultaneously in order to avoid omitted variable bias. His analysis suggests that globalization has no effect on public education expenditures. One reason why most of these studies fail to identify significant effects of global economic integration on educational policies is that these effects may only be observed at lower levels of aggregation.

The second strand of the theoretical literature emphasizes the effect of increased trade on wages for low- and high-skilled labor and discusses how this distortion in wages affects educational policies. Ansell (2008), as the only theoretical contribution along these lines, bases the analysis entirely on the Heckscher-Ohlin model and derives that the impact of globalization on education expenditures differs between developed and developing countries. In developing countries, primary education expenditures are expected to increase relative to tertiary education expenditures, whereas the opposite effect is expected for developed countries.

Based on estimations with country averages over the 1990s, Ansell (2008) finds confirmation for the implications of the theoretical analysis. However, the investigation neglects the dynamics of both globalization and the composition of public education expenditures. In addition, given the studies that refute the Heckscher-Ohlin theorem regarding globalization's influence on wages in developing countries (Goldberg and Pavenik, 2007) the theoretical foundation for Ansell's findings might be questioned.

The above literature review illustrates that the bulk of the literature examining globalization's influence on public education emphasizes the role of tax competition. In addition, it has to be noted that the studies in the tax competition literature focus on the effect of globalization on *aggregate* education expenditures while neglecting effects on the composition of education spending. The only study analyzing globalization's influence on the composition of public education expenditures that we know of, Ansell (2008), is exclusively based on the Heckscher-Ohlin theorem. However, this theorem hardly finds confirmation in the empirical

literature. Moreover, evidence in favor of this theoretical model by Ansell is based on one cross-sectional investigation alone.

The contribution of our paper is that we address each of the aforementioned shortcomings. First, we derive a theoretical model that incorporates domestic adjustments in taxation due to global economic integration, while at the same time taking into account globalization's effect on wages as identified in the empirical literature. Second, the implications of the theoretical model are tested by investigating globalization's influence on spending for primary, secondary and tertiary education. Third, we conduct our estimations with panel data and apply dynamic estimation techniques in order to make use of the over-time variation in our dataset.

3 Theoretical model

In this section, we develop a stylized model to study the link between globalization and public expenditures for different educational stages. More specifically, after setting up the basic structure of the model in sections 3.1–3.3, we explore in section 3.4 how globalization affects the endogenous variables in the model, i. e. public education expenditures and the domestic tax rate.

3.1 Individuals

Consider a country with a population mass of 1. An individual $i \in H, L$ has an exogenously given ability that qualifies her for one and only one type of labor: "high-skilled" (H) or "low-skilled" (L) work. The wage that this individual earns for one unit of effective labor is w_i. The effective labor supply of individual i depends on the amount of public expenditures g_i that the government invests in her education. Public education expenditures are hence assumed to be productivity-enhancing. Individual i's market income ν_i is consequently specified as $\nu_i(w_i, g_i)$ with $\frac{d\nu_i}{dw_i} > 0$, $\frac{d\nu_i}{dg_i} > 0$, $\frac{d^2\nu_i}{dg_i^2} < 0$, and $\frac{d^2\nu_i}{dg_i dw_i} > 0$.

These assumptions imply (i) that increasing wages and an increasing effective productivity due to more funding for the relevant educational stages raise the market income of individual i; (ii) that education expenditures have a diminishing marginal effect on income; and (iii) that the marginal effect of education expenditures on income rises with higher wages.

The idea behind these assumptions is that the ability and talents of the individuals in the model are not substitutable. An individual with analytical abilities can only pursue an academic career, whereas an individual with practical skills can only work in "practical jobs". However, possessing the respective abilities is not sufficient. Individuals have to receive an appropriate education before their talent can be productively applied.

This set-up of the model implicitly assumes that high-ability individuals do not benefit from increased funding for basic education, and vice versa. In essence, we are assuming that different ability types are educated separately. In reality, this is of course not true. In

many countries, low- and high-skilled individuals are educated jointly during primary and to some extent even during secondary school; tracking only occurs during the later stages of their educational careers. Therefore, high-ability individuals who eventually acquire secondary and tertiary education will benefit to some extent from additional funding for primary education.

The question is whether such benefits can be ignored for modeling purposes. There is reason to believe that such an approach is justifiable. High-ability individuals are likely to master the skills taught in primary schools – reading, writing, and basic mathematics – as long as these schools fulfill some minimum quality requirements; increased funding is not likely to improve their educational outcomes substantially at this stage of their educational careers. In addition, to the extent that the ability of students and their family background in terms of wealth and educational achievements of parents are correlated, high-ability students should have better opportunities to acquire critical skills outside of (potentially low-quality) schools. For these reasons, increased funding for primary education will, on balance, help low-ability students much more than high-ability students (see also Hansen and Weisbrod (1969) and Blanden and Machin (2004) on this).

3.1.1 Emigration

One important constraint the government faces when formulating its fiscal policy is that individuals may emigrate if the tax burden is too high.[9] To model such mobility decisions, we presume that every individual takes the tax rate into account when deciding whether to emigrate or not. Individuals will remain in the home country if the following condition holds:

$$(1-t)\nu_i + \epsilon_i \geq (1-t^F)\nu_i - x, \tag{1}$$

with t^F denoting the tax rate in case of emigration (the "foreign" tax rate), x denoting the costs of emigration, ϵ_i a random parameter that measures the home attachment of a given individual, and ν_i denoting individual i's income. We assume that $\epsilon_i \sim U(0,1)$, i. e. that home attachment is uniformly distributed over $[0,1]$. An individual will emigrate if the difference between his net-income in the foreign country is larger than her home attachment and the mobility costs.

Given that ϵ_i is random, every individual's mobility decision is stochastic. The probability π_i that an individual will remain in the country can be expressed as a function of the domestic tax rate and the mobility costs:

$$\pi_i = \pi_i(\nu_i, t, x) = F(\epsilon_i \geq z) = 1 - z, \tag{2}$$

with $z = (t - t^F)\nu_i - x$, $\frac{d\pi_i}{dt} = -\nu_i$, $\frac{d\pi_i}{dx} = 1$, and $\frac{d\pi_i}{d\nu_i} = -(t - t^F)$.

[9] Assuming that the production factors are supplied endogenously would lead to an alternative tax base effect. We ignore this effect in order to keep the model tractable.

Note that even though neither home attachment nor mobility costs vary between individuals, the fact that they evaluate their net-incomes when deciding whether to emigrate implies that high-income (and thus high-ability) individuals are more likely to emigrate for tax purposes: given a proportional tax, wealthier individuals gain more in absolute terms. Note furthermore that we treat the foreign tax rate as exogenously fixed. There will be, therefore, no explicit tax competition between the domestic and foreign governments. Instead, the domestic government takes the foreign tax rate as given. Given the types of domestic governments that we analyze below, this assumption is appropriate. That is, we analyze education expenditure choices for both benevolent and Leviathan governments. As we will show below, a benevolent government concerned with maximizing the aggregate income of its citizens (irrespective of whether they eventually decide to emigrate or not) disregards international differences in tax rates and how these affect mobility decisions. Only for a Leviathan government, tax competition will matter. But empirically, the assumption of a Leviathan governments is more appropriate for poor and economically weak countries. In general, these countries have to take the tax rates of foreign and economically powerful countries as given. We assume furthermore that t^F is sufficiently small relative to x and ϵ_i, so that the foreign tax rate represents a binding constraint on the tax policy on the domestic government. We also exclude for simplicity the possibility of *immigration* from foreign countries.

3.2 The government

As indicated previously, we derive the equilibrium first under a benevolent government and then under a Leviathan government.

3.2.1 Benevolent governments

A benevolent government maximizes net-incomes V of its citizens. Its objective function can be expressed as

$$\max_{g_i,t} V = \int_0^1 \nu_i \, di - t \int_0^1 \pi_i \nu_i \, di, \tag{3}$$

under the constraint $t \int_0^1 \pi_i \nu_i \, di = \int_0^1 g_i \, di$ and with $g_i \geq 0, 0 \leq t \leq 1$. Thus, the government is exclusively concerned with maximizing the aggregate income of its citizens, irrespective of whether they emigrate or not. Furthermore, total tax revenues equal total education expenditures in an equilibrium with a benevolent government, and the only individuals that can be taxed are those that remain in the country. Therefore, education expenditures perfectly determine tax rates. Using this constraint to substitute for t in equation (3), we obtain

$$\int_0^1 \nu_i \, di - \int_0^1 g_i \, di. \tag{4}$$

Differentiating this expression with respect to g_i gives as first-order condition

$$\frac{d\nu_i}{dg_i} - 1 = 0 \quad \forall i. \tag{5}$$

Interpreting this first-order condition is straightforward. In equilibrium, a benevolent government chooses education expenditures $g_i = g_i^{b*}$ for individual i such that the marginal increase in income equals the social costs of providing another unit of education for that individual, which are 1. The tax rate paid by an individual that remains in the home country is then $t^{b*} = \frac{\int_0^1 g_i^{b*}\, di}{\int_0^1 \pi_i(g_i^{b*})\nu_i(g_i^{b*})\, di}$. Note that this equilibrium effectively implies a redistribution from those that remain in the home country to those that emigrate. Given, as argued above, that the high-skilled and thus high-earning individuals are more likely to emigrate, the educational policy by a benevolent government that maximizes aggregate income leads effectively to redistribution in favor of the high-skilled.[10]

3.2.2 Leviathan governments

The assumption of benevolent governments might not be appropriate for several countries; in particular developing countries are often ruled by governments that can be characterized as Leviathans: politicians who seek to maximize their own incomes (Andersson and Konrad, 2003b). We therefore analyze in this section the equilibrium assuming that the government is exclusively concerned with rents R defined as tax receipts minus total expenditures for education. The objective function is in this case

$$\max_{g_i,t} R = \int_0^1 (t\pi_i\nu_i - g_i)\, di \tag{6}$$

with $g_i \geq 0, 0 \leq t \leq 1$.

Thus, education expenditures that increase individuals' incomes are only of interest to the government as far as they lead to higher rents.

In contrast to the case with a benevolent government – where taxes were determined residually – education expenditures and the tax rate are determined simultaneously when the government is a Leviathan. The reason is that the government is interested in tax revenues not only to fund education expenditures, but also in order to finance its own consumption.

Maximizing equation (6) with respect to g_i reveals that education expenditures are characterized in equilibrium by

$$t\pi_i\frac{d\nu_i}{dg_i} + t\frac{d\pi_i}{d\nu_i}\frac{d\nu_i}{dg_i}\nu_i - 1 = 0 \quad \forall\, i. \tag{7}$$

[10]This result would change, of course, if the government maximized aggregate utility and not aggregate income. However, utility is unobservable in reality, and most governments claim to be interested in maximizing GDP. Therefore, this result probably describes real-world policy choices in well-run countries (i. e. countries whose governments are close to being benevolent) arguably well.

This expression shows that the government chooses education expenditures for every individual i such that the increase in expected tax revenues due to a marginal increase in education expenditures is equal to the costs. The costs of additional education expenditures for a Leviathan government are twofold. First, it has to incur the direct unit costs of education: providing one unit of additional education costs one unit of tax revenues. However, there is also a tax base effect. As wealthier individuals are more likely to emigrate for tax reasons, increased spending on education will incentivize more individuals to emigrate, thereby reducing the tax base of the government. This effect is captured by the expression $t\frac{d\pi_i}{d\nu_i}\frac{d\nu_i}{dg_i}\nu_i = -t(t-t^F)\frac{d\nu_i}{dg_i}\nu_i < 0$.

Maximizing equation (6) with respect to t leads to the following first order condition

$$\int_0^1 \left(\pi_i\nu_i + t\frac{d\pi_i}{dt}\nu_i\right) di = 0. \tag{8}$$

This equation states that the tax rate is set such that in equilibrium, any additional revenues due to a marginal increase in the tax rate are equal to the revenue losses due to emigration. Equation (7) and (8) together define the equilibrium tax $t = t^{l*}$ and equilibrium education expenditures $g_i = g_i^{l*}$ under a Leviathan government. It is obvious by comparing equations (5) and (7) that even if a Leviathan government could set $t = 1$, education expenditures for type i would be lower than under a benevolent government because the Leviathan government takes into account that better educated individuals are more likely to emigrate, thereby depriving the government of the opportunity to tax them.

3.3 Economic effects of globalization

In this section, we describe the effects of globalization on wages and mobility costs, which are independent of the type of government. Prima facie, globalization is assumed to have two direct effects. On the one hand, it affects wages for different skill-types. On the other hand, it reduces the costs of mobility. Via these two channels globalization indirectly influences the tax rate and education expenditures that the government chooses in equilibrium, i. e. it will eventually have fiscal effects.

3.3.1 Globalization and wages

Trade theory suggests a link between the extent of economic integration and factor returns. The Heckscher-Ohlin model and the related Stolper-Samuelson theorem, for example, state that falling trade restrictions lead to an equalization of factor prices through an increase in the trade of goods (Krugman and Obstfeld, 2005).

We therefore model the wage of individual i as a function of globalization G:

$$w_i = w_i(G). \tag{9}$$

How does globalization affect the wage for individual i, i.e. what is the sign of $\frac{dw_i}{dG}$? According to the Heckscher-Ohlin model, the sign of this expression depends on (i) the skill level of individual i and (ii) whether she lives in a developing or industrialized country. Given that industrialized countries are relatively abundant in high-skilled labor and developing countries have a relative abundance in unskilled labor, one prediction of the Heckscher-Ohlin model is that the returns to low-skilled labor increase in developing and decrease in industrialized countries with deepening globalization, and vice versa for high-skilled labor. The empirical evidence, however, confirms the predictions of the Heckscher-Ohlin model only partially. That is, globalization has apparently led to a relative rise in wages for high-skilled labor in industrialized (Feenstra and Hanson, 1999) *and* developing countries (Goldberg and Pavenik, 2007).

3.3.2 Globalization and mobility costs

The mobility costs x can be understood as the monetary representation of the costs of losing contact or keeping in touch with one's social and professional networks, and as the costs of relocating physical assets. One effect of globalization is that it lowers transportation costs, which implies that it becomes easier to visit one's acquaintances in the home country, or to relocate physical assets. Another effect is the spread of English as a modern Lingua Franca and the emergence of a global culture, both of which might reduce the non-monetary costs when moving to a foreign country. It is therefore reasonable to assume that mobility costs are a decreasing function of the extent of globalization, i. e., $x = x(G)$ with $\frac{dx}{dG} < 0$.

3.4 Fiscal effects of globalization

3.4.1 Comparative statics under a benevolent government

Deriving how globalization affects education expenditures and taxation under a benevolent government requires the implicit differentiation of equation 5 with respect to G. Rearranging the different terms results in

$$\frac{dg_i}{dG} = -\frac{\frac{d^2\nu_i}{dg_i dw_i}\frac{dw_i}{dG}}{\frac{d^2\nu_i}{dg_i^2}} \quad \forall i. \tag{10}$$

The sign of this expression is determined by $\frac{dw_i}{dG}$. If globalization leads to an increase in wages for an individual with skill-type i, $\frac{dw_i}{dG} > 0$, the benevolent government will spend more on education for that type. In contrast, if $\frac{dw_i}{dG} < 0$, then the government will spend less for type i. For example, if globalization leads to an increase in the returns for high-skilled labor and a decrease in the returns for low-skilled labor in a country with a benevolent government, the model predicts an increase in expenditures for higher education and a decrease in expenditures for basic education.

3.4.2 Comparative statics under a Leviathan government

The comparative statics for Leviathan governments are more intricate than for benevolent governments. For example, assume that globalization decreases mobility costs and increases the wages for high-skilled labor. How do these effects influence the government's policies? Decreasing mobility costs induce governments to cut tax rates. This means, ceteris paribus, that fewer resources are available for public education across all educational stages. On the other hand, rising wages for the high-skilled incentivize the government to expand expenditures for higher education. This attempt to increase education expenditures will counteract the incentives to decrease tax rates, possibly to such an extent that tax rates will be higher in the new equilibrium. But then again, wealthier individuals are also more likely to emigrate. This means that the Leviathan government has an incentive to decrease education expenditures if wages increase in order to ensure that individuals' gain from emigration is not "too large". Reduced expenditures for education, in turn, enable the government to decrease the tax rate to some extent in order to motivate more individuals to remain in the country.

In general, therefore, it is impossible to derive how education expenditures will react to deepening globalization under a Leviathan government. The comparative statics of globalization depend on the specific values of the parameters and variables at a particular equilibrium. This can be formally shown by implicitly differentiating the system of equations given in (7) and (8) with respect to G. Implicitly differentiating equation (7) results in

$$\frac{dg_i}{dG} = \frac{\left(-\pi_i + (t-t^F)\nu_i\right)\left(\frac{dt}{dG}\frac{d\nu_i}{dg_i} + t\frac{d\nu_i^2}{dg_i dw_i}\frac{dw_i}{dG}\right) - t\frac{d\nu_i}{dg_i}\left(\frac{dx}{dG} - 2\frac{dt}{dG}\nu_i - 2(t-t^F)\frac{d\nu_i}{dw_i}\frac{dw_i}{dG}\right)}{t\left(\pi_i - (t-t^F)\nu_i\right)\frac{d^2\nu_i}{dg_i^2} - 2t(t-t^F)\left(\frac{d\nu_i}{dg_i}\right)^2} \quad \forall i. \tag{11}$$

Implicitly differentiating equation (8) gives

$$\int_0^1 \left(\nu_i\frac{dx}{dG} - 2\nu_i^2\frac{dt}{dG} + \left(\pi_i - (t-t^F)\nu_i - 2t\nu_i\right)\left(\frac{d\nu_i}{dg_i}\frac{dg_i}{dG} + \frac{d\nu_i}{dw_i}\frac{dw_i}{dG}\right)\right)di = 0. \tag{12}$$

As discussed above, it is not possible to sign either $\frac{dg_i}{dG}$ or $\frac{dt}{dG}$ given the various effects and differing incentives with which a Leviathan government is confronted if globalization increases. For example, the denominator on the right-hand side in equation (11) can be either positive or negative, which implies that the right-hand side of this equation as a whole cannot be signed. Given that $\frac{dg_i}{dG}$ is indeterminate, it is not clear whether $\frac{dt}{dG}$ will be positive or negative. Note also that it is not possible to substitute for $\frac{dt}{dG}$ in equation (11) with exogenous variables because equation (12) cannot be explicitly solved for $\frac{dt}{dG}$.

3.4.3 Discussion

The model developed in the previous sections establishes a link between globalization and different types of education expenditures. If we are willing to assume that governments of industrialized countries, at least to some degree, behave benevolently and if we accept the empirical evidence regarding the effects of globalization on wages for different skill-types discussed in section 3.3.1, then we should observe a positive relationship between globalization and higher education expenditures and presumably a negative relationship between globalization and lower education expenditures.[11] For developing countries, the assumption of Leviathan governments might be on average more appropriate. Consequently, we cannot make a clear prediction based on our model how globalization will affect expenditures for different types of education in this group of countries. Given such ambiguities in the theoretical model, we conduct an empirical analysis in the next section.

4 Data and methodology

4.1 Data description

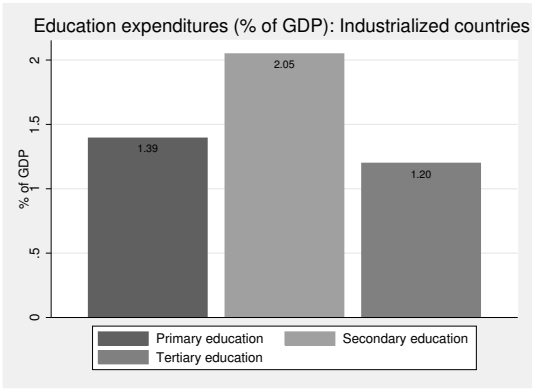
The education expenditure data that we use in the following is obtained from the World Bank's Edstats database (original source: UNESCO Institute of Statistics).[12] The data is comprehensive in the sense that all education-relevant expenditures of public entities are covered, including expenditures by different tiers of government (Lassibille and Rasera, 1998). Figure 1 is based on averages for developing and developed countries across the period from 1992 till 2006. The two bar charts illustrate to what extent spending for different educational programs (relative to GDP) differs on average between these two country groups. They suggest that OECD countries spend, relative to their GDP, less on primary education than developing countries (1.39% vs. 1.78%). On the other hand, OECD countries spend more for secondary (2.05% vs. 1.54%) and tertiary education (1.20% of GDP vs. 0.82% of GDP) than developing countries.

It may appear surprising that primary education expenditures as a share of GDP are larger in developing than in industrialized countries. One explanation are the higher fertility rates in developing countries. As fertility rates decline (for example because of increased female education), spending for primary education as a share of GDP will probably decline as well.[13]

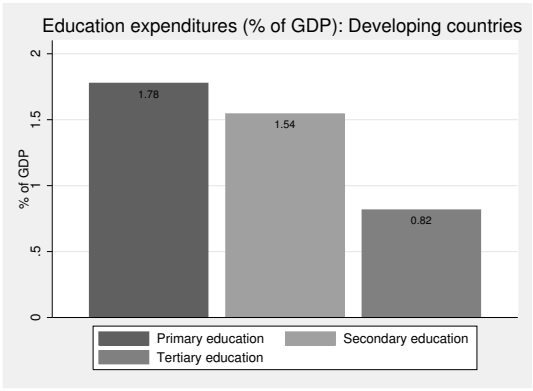
[11] While the model would in no case predict that expenditures for lower education increase if returns for low-skilled labor decline, this might be possible in reality if high-skilled individuals benefit sufficiently from lower education; see the discussion in section 3.1.

[12] The Edstats database provides data on primary, secondary and tertiary education expenditures as a share of total education expenditures. We construct the data for expenditures on the three educational stages as a share of GDP by multiplying expenditures on the three educational stages as a share of total education expenditures by total education expenditures as a share of GDP. The data for total education expenditures as a share of GDP is from the Edstats database as well.

[13] We thank an anonymous referee for suggesting this explanation.



(a) Industrialized (OECD) countries



(b) Developing (non-OECD) countries

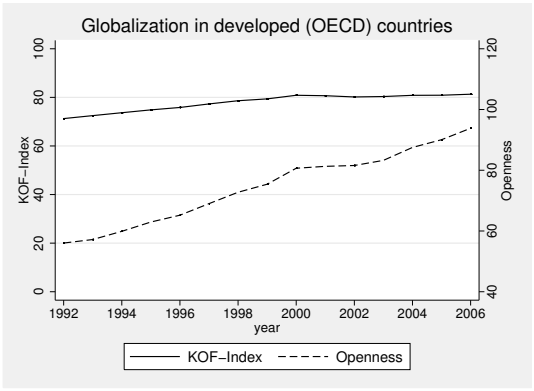
Figure 1: Public education expenditures in % of GDP, 1992 - 2006
Source: World Bank Edstats database

To measure globalization, we use two proxies: the KOF-Index (Dreher, 2006) and the trade openness measure (at constant prices) from the Penn World Tables. The KOF-Index is based on three sub-indexes which capture the extent of economic, social, and political globalization (e.g. actual economic flows, economic restrictions, data on information flows, data on personal contact, and data on cultural proximity). The KOF-Index consequently provides a more comprehensive picture than the traditionally used trade openness measure. Nonetheless, we also use the trade openness measure from the Penn World Tables as a second proxy for global economic integration to examine the robustness of the results. The evolution of the two measures of economic integration is plotted separately for developed and developing countries from 1992 onwards in figure 2.

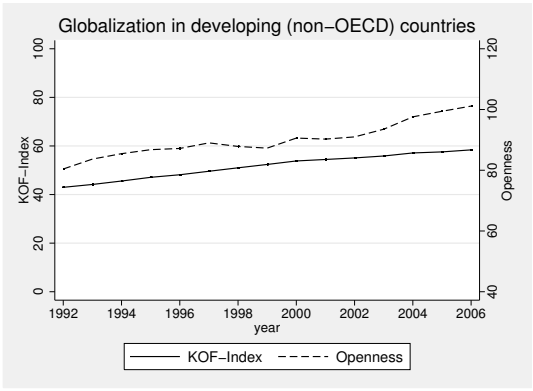
Both measures suggest that globalization has increased in the two country groups. The extent of trade openness is higher for developing than for developed countries throughout the entire period from 1992 to 2006. This observation can be attributed to the fact that poor countries are in general more dependent on international trade. In contrast, the KOF-Index has been at least 20 points higher in developed countries during this period, which may reflect the fact that in terms of cultural proximity and information flows wealthier countries are more globalized. The differences between the two globalization measures underline the rationale for including both of them in the regression analysis.

The first control variable that we include in the panel data estimations is the first lag of the dependent variable in order to capture dynamic effects in the composition of public education expenditures. Further control variables are: (i) the gross enrollment rate in the relevant educational stage and its prior stages[14], which represents the demand for the respective type

[14]That is, when explaining primary education expenditures, we control for gross primary enrollment. When explaining secondary education expenditures, we control for gross primary and gross secondary enrollment. And when explaining tertiary education expenditures, we control for gross primary, gross secondary, and gross tertiary enrollment. As noted by an anonymous referee, it is important to control for gross enrollment in prior stages of education since prior enrollment rates affect how fast the government can increase expenditures for



(a) Industrialized (OECD) countries



(b) Developing (non-OECD) countries

Figure 2: Evolution of globalization over time, 1992 - 2006
Sources: Penn World Tables and Dreher (2006)

of education; (ii) GDP per capita, which captures how a country's income level is related to the structure of education expenditures; (iii) a measure of government ideology[15], which controls for systematic partisan biases in education expenditures; (iv) an index of democracy[16], which measures to what extent the government is accountable to the electorate and (v) the number of internet users per 100 persons as a measure for technological progress. The latter is a particularly important control variable. By including the number of internet users, we attempt to distinguish between changes in spending for the three educational programs that are due to country-specific technological change (Bartel and Lichtenberg, 1987, 1991), and changes due to globalization.

The unbalanced panel covers altogether 104 countries, both developing and developed, over the 1992 - 2006 period.[17] Summary statistics, variable definitions, and data sources for all variables used in the subsequent regressions are collected in table A.1; a list of the countries that are considered in this study can be found in table A.2. Both tables are in the appendix.

4.2 Empirical strategy

We estimate three dynamic panel data models to analyze the effect of globalization on primary, secondary, and tertiary public education expenditures relative to GDP. In order to take into account that the overall effect of globalization may differ between developing and industrialized countries, the models are specified as follows:

later stages. For example, the government will find it easier to increase spending for tertiary education if gross primary and gross secondary enrollment rates are already high.

[15]The ideology variable is derived from the DPI dataset. Whereas this dataset distinguishes between right, center, left, and other governments, we use, for compactness, a 0 - 1 classification. We code observations with governments that are explicitly identified as left-wing as 1 and all other observations as 0.

[16]The index is 1 when citizens have the highest and 7 when they have the lowest amount of political rights.

[17]Since fixed effects are included in equation 13, each of the countries in the sample has at least two non-missing observations during the time frame of the analysis.

$$\begin{aligned}\text{Expenditure/GDP}_{it} =& \delta \text{Globalization}_{it} \times IND_i + \gamma \text{Globalization}_{it} \times DEV_i \\ &+ \alpha \text{Expenditure/GDP}_{i,t-1} + \mathbf{x_{it}}\beta + \omega_t + \lambda_i + \epsilon_{it},\end{aligned} \tag{13}$$

where $Expenditure/GDP_{it}$ is public education expenditures allocated to primary, secondary, or tertiary education relative to GDP, $Expenditure/GDP_{i,t-1}$ represents the lag of the dependent variable, λ_i are the country fixed effects, ω_t are the year fixed effects, x_{it} represents a vector of control variables, and ϵ_{it} is the error term.

Two variables are used in equation 13 to allow us to investigate differences in the effect of globalization on education expenditures across country groups. The first variable is constructed by interacting a measure of globalization with a dummy variable, IND_i, that is 1 for industrialized countries and else 0. The second variable interacts the same measure of globalization with a dummy variable, DEV_i, that is 1 for developing countries and else 0. We classify all countries as either industrialized or developing (see table A.2).[18] We are interested in the estimates for δ and γ, the coefficients on the interaction variables: δ measures the effect of globalization in industrialized countries, whereas γ measures its effect in developing countries.

Note that we do not include industrialized and developing country dummies, i.e., the "lower-order" effects of these dummies, as separate control variables in equation 13 because they are multicollinear with the country fixed effects. We also do not include a lower-order effect for the globalization variable because it is multi-collinear with a linear combination of the interaction effects. It may seem that the non-inclusion of the lower-order effects leads to an omitted variable bias (Braumoeller, 2004). This concern is, however, unwarranted.[19]

Due to the presence of fixed effects and the lagged dependent variable in equation 13, pooled OLS estimations are inconsistent. However, it is well-known that the application of the within-estimator to dynamic models also yields biased estimates (Nickell, 1981). While the within-estimator is consistent and the Nickell-bias can be ignored when T is large, this bias may be serious in panels with a small time dimension. Since T is on average around 6 in our dataset (even though observations are in principle available from 1992-2006, there are

[18] Any classification of countries as industrialized or developing is of course arbitrary. We classify only countries that were members of the OECD at some point during the sample period as industrialized. Therefore, the term developing as used in this paper should not be understood as being synonymous with, for example, the Least Developed Countries (LDC). It should rather be understood as encompassing all countries except the most wealthy.

[19] To see why, note that the complete specification of a model with country fixed effects and interactions of a continuous control variable with a dummy variable is: $y_{it} = \alpha_i + \beta_1 d_i + \beta_2 x_{it} + \beta_3 d_i x_{it} + \epsilon_{it}$, with $d_i \in \{0, 1\}$ (we omit other control variables for brevity). Thus, β_2 is the marginal effect of x when $d_i = 0$ whereas $\beta_2 + \beta_3$ is the marginal effect when $d_i = 1$. This expression is equivalent to $y_{it} = \alpha_i + \beta_1 d_i + \beta_2 (d_i x_{it} + (1 - d_i) x_{it}) + \beta_3 d_i x_{it} + \epsilon_{it}$, which can be rewritten as $y_{it} = \alpha_i + \beta_1 d_i + \beta_2 (1 - d_i) x_{it} + (\beta_2 + \beta_3) d_i x_{it} + \epsilon_{it}$, or $y_{it} = z_i + \gamma c_i x_{it} + \delta d_i x_{it} + \epsilon_{it}$, with $z_i = \alpha_i + \beta_1 d_i$, $c_i = (1 - d_i), \gamma = \beta_2, \delta = (\beta_2 + \beta_3)$. This last expression has the same structure as equation 13. Since it is equivalent to the complete specification, the same is true for equation 13.

missing variables), it is obvious that more sophisticated estimation methods are required for the empirical analysis.

Several IV and GMM estimators have been developed in order to deal with the bias in dynamic panel data models. For models where it cannot be assumed that disturbances are spherical, the Arellano-Bond Difference GMM and Blundell-Bond System GMM estimators outperform their alternatives (Roodman, 2009a). Between these two, the choice of the appropriate estimator depends on whether the dependent variable is persistent or not since for persistent dependent variables the Difference-GMM estimator gives rise to finite sample biases. In this case, the System-GMM estimator is recommended (Blundell and Bond, 1998, 2000). Since education expenditures are likely to be persistent, we apply the robust one-step System-GMM estimator. Moreover, we use a collapsed "GMM-style" instruments set to address the instrument proliferation problem (Roodman, 2009b).

5 Estimation results

5.1 Baseline regressions

The results for the System-GMM estimations of model 13 are collected in table 1. In the first three models (column 2 to 4), the KOF-Index is used as the proxy for globalization, while the last three models (column 5 to 7) are estimated using the trade openness measure. There are three models for each globalization proxy due to the use of multiple dependent variables: primary, secondary, and tertiary education expenditures relative to GDP.

First, note that the diagnostic tests reported at the bottom of table 1 confirm the validity of the set of instruments for all models. This can be deduced from the fact that the Hansen-J overidentification test is never rejected, while in addition second-order autocorrelation in the differenced errors is not found for any of the models (first-order autocorrelation in the differenced errors is expected and does not invalidate the estimates). The number of instruments is also smaller than the number of cross-sections, so that a bias due to instrument proliferation is not likely (see also section 5.2 for the findings from robustness checks).

The estimates suggest that deepening globalization leads to lower spending for primary and more spending for tertiary education in both industrialized and developing countries. The coefficients for globalization when the KOF-Index is used are negative in the model for primary and positive in the models for secondary and tertiary education expenditures. The coefficients are, except for primary education expenditures, at least significant at the 10% level. However, note that the z-statistics are relatively large in the primary education expenditures regressions.

The results are qualitatively similar when the openness measure of globalization is used even though the coefficients are consistently insignificant. This is in line with our expectations since the KOF-Index is a more comprehensive measure of globalization than trade openness.

Another noteworthy difference to the results with the KOF-Index is that openness has a positive effect on primary education expenditures in developing countries even though the z-statistic is low for this coefficient.

We summarize these results as follows. For industrialized and developing countries, the evidence suggests a negative relationship between the KOF-Index and primary education expenditures, while the results are less convincing when the openness measure is used. The evidence regarding secondary and tertiary education expenditures suggests that globalization has increased spending for these types of educational programs in both industrialized and developing countries. Again, the effects are stronger when the KOF-Index is used.

The magnitudes of the estimated coefficients for the globalization variables are remarkably similar for industrialized and developing countries. A 1-point increase in the KOF-Index reduces the share of primary education expenditures relative to GDP by around 0.008 percentage points in industrialized and by about 0.006 percentage points in developing countries. At the same time, a 1-point increase in the KOF-Index is associated with a rise in the secondary education expenditure to GDP ratio by 0.014 percentage points in industrialized and 0.015 percentage points in developing countries. With respect to tertiary education expenditures, we find that a 1-point increase in the KOF-Index results in spending increases of 0.007 and 0.008 percentage points in industrialized and developing countries, respectively.

Considering that the average increase in the KOF-index was about 10 points for industrialized and about 15 points for developing countries over the 1992 - 2006 period (see figure 1), the estimated coefficients for the globalization variables point towards significant readjustments in educational spending. According to our estimations, globalization has reduced primary education expenditures on average by 0.08% of GDP in industrialized countries during the 1992-2006 period. Given that average primary education expenditures in industrialized countries amounted to 1.39% of GDP during the sample period (see figure 1), a reduction of 0.08 percentage points implies an average decline of about 6% in the primary education expenditure to GDP ratio relative to the average of this ratio during the sample period. Similarly, secondary education expenditures in industrialized countries increased by about about 7% and tertiary education expenditures by about 6%, relative to the average in industrialized countries during the sample period. For developing countries, the respective decline in primary education expenditures is about 5%, the increase in secondary education expenditures is about 15%, and the increase in tertiary education expenditures is about 15% as well.

With regard to the trade openness measure, the effects appear much smaller at first sight. However, as figure 2 shows, this measure has a wider value range than the KOF-Index. Nevertheless, the estimated effects of globalization are indeed somewhat smaller when the openness measure instead of the KOF-Index is used. The 38 and 21 point increases in the trade openness measure over the 1992 - 2006 period suggest, for example, an average increase in the share of tertiary education expenditures relative to GDP by around 0.038 percentage

Table 1: Globalization and education expenditures (% of GDP) in 1992–2006, System GMM

Dependent variable	Primary educ. exp.	Secondary educ. exp.	Tertiary educ. exp.	Primary educ. exp.	Secondary educ. exp.	Tertiary educ. exp.
	KOF - Globalization Index			**Openness (Penn World Tables)**		
Prim. edu. exp./GDP$_{t-1}$	0.461*			0.610**		
	(1.805)			(2.397)		
Sec. edu. exp./GDP$_{t-1}$		0.418**			0.561***	
		(2.105)			(2.918)	
Tert. edu. exp./GDP$_{t-1}$			0.528**			0.677***
			(2.298)			(4.287)
Primary enrollment	0.006	-0.004	-0.000	0.004	-0.003	0.000
	(0.991)	(-1.179)	(-0.107)	(0.748)	(-1.231)	(0.022)
Secondary enrollment		0.000	-0.002		0.004	-0.000
		(0.089)	(-1.366)		(1.259)	(-0.453)
Tertiary enrollment			0.002			0.003**
			(1.528)			(2.115)
GDP per capita	-0.001	-0.003	0.003	-0.002	0.001	0.005
	(-0.194)	(-0.502)	(0.834)	(-0.566)	(0.174)	(1.504)
Internet users	0.003	0.004**	0.002	0.003	0.002	0.001
	(1.281)	(2.013)	(1.433)	(1.139)	(1.292)	(0.597)
Democracy	0.003	0.011	0.030*	0.020	0.005	0.022**
	(0.098)	(0.285)	(1.908)	(0.962)	(0.155)	(2.062)
Government ideology	0.007	0.105*	0.056	0.032	0.131**	0.049
	(0.117)	(1.713)	(1.133)	(0.569)	(2.179)	(1.338)
KOF-Index × IND	-0.008	0.014**	0.007**			
	(-1.536)	(2.516)	(2.149)			
KOF-Index × DEV	-0.006	0.015***	0.008**			
	(-1.406)	(2.635)	(2.118)			
Openness × IND				-0.001	0.001	0.001
				(-0.971)	(0.750)	(1.568)
Openness × DEV				0.001	0.001	0.001
				(0.692)	(1.208)	(1.329)
N	529	523	530	544	536	546
χ^2	127.938	482.166	548.315	276.525	588.228	915.269
Hansen-test (p-val.)	0.437	0.344	0.654	0.244	0.377	0.323
AR(1)-test (p-val.)	0.111	0.024	0.047	0.053	0.022	0.003
AR(2)-test (p-val.)	0.556	0.153	0.287	0.934	0.149	0.286
Instruments No.	33	36	37	33	36	37

[1] Stars indicate significance levels at 10% (*), 5% (**) and 1%(***)
[2] z-statistics in parentheses
[3] Year fixed effects included in all models
[4] The p-values for the Hansen overidentification test, the p-values for the Arellano-Bond AR(1) and AR(2) tests, and the number of instruments are reported at the bottom of the table
[5] Hypothesis tests are based on one-step robust standard errors
[6] The GMM-style instruments set has been collapsed

points in industrialized and by about 0.021 percentage points in developing countries. Relative to average spending for this educational stage during the sample period, these increases imply a rise of about 3% in both industrialized and developing countries relative to the average of this ratio during the sample period. (However, one should bear in mind that the coefficients are insignificant in these estimations).

The remaining control variables perform reasonably. The lagged dependent variable is significantly positive with a coefficient between 0.4 and 0.7 for all expenditure categories, suggesting a high degree of persistence in education expenditures. We also find that the number of internet users, which is used as a proxy for technological progress, is positively related to all three types of education expenditures. While the coefficient is significant in only one case, it consistently displays large z-statistics. Hence, we conclude that technological progress leads to an expansion of all types of education. Enrollment rates have in general an insignificant effect on spending. The only exception is the effect of the tertiary enrollment rate on tertiary education expenditures. This variable is consistently positive; it is also significant in the openness regression.

Another interesting result is that the democracy index is significantly positive for tertiary education expenditures. Taking into account the inverted scaling of the democracy index (see table A.2), these estimates imply that more democratic countries spend less on tertiary education. This can be attributed to the fact that more democracy usually implies an extension of political rights to the less wealthy parts of society. These groups in turn benefit less from tertiary education. Alternatively, non-democratic countries could spend more on tertiary education because the children of the elite benefit the most from this type of education. While the coefficient for democracy is also positive in the regressions for primary and secondary education expenditures, it displays low z-statistics and is far from significant. There is thus no robust evidence that democracy has any effect on primary and secondary education expenditures.

The coefficient for GDP per capita is insignificant in all models. Finally, the coefficient for government ideology is consistently positive. It is significant in the secondary education expenditures. More generally, the estimated coefficient displays relatively high z-statistics in the secondary and tertiary education expenditures regressions, but low z-statistics in the primary education expenditures regressions. There is thus weak evidence that left-wing governments spend more than right-wing governments on secondary and possibly tertiary education, but no evidence for partisan biases with respect to primary education expenditures.

5.2 Sensitivity analysis

This section provides the results for three robustness checks that are conducted in addition to using two different globalization measures. The estimations in tables 2 and 3 address potential

deficiencies of the baseline estimations from an econometric viewpoint. To save space, we only report the estimates for the globalization variables. The full results are available upon request.

The first robustness check involves a re-estimation of the models in table 1 by means of a two-step procedure using the Windmeijer-correction instead of the robust one-step procedure. While the two-step procedure is asymptotically efficient and robust to arbitrary forms of heteroscedasticity and autocorrelation, the Windmeijer-correction has been designed to deal with a potential finite sample bias in the calculation of the associated standard errors. Without the correction, a downward bias in the standard errors is possible (Windmeijer, 2005).

Generally, we find that the results in table 2 confirm the conclusions drawn with regard to the estimation results in table 1. Globalization reduces primary education expenditures and increases secondary and tertiary education expenditures. The most noteworthy difference to the baseline regression is that the coefficient for the KOF-Index is significant in the primary education expenditure model for industrialized countries. The coefficient estimates in the regressions for secondary and tertiary education expenditures for the KOF-Index continue to be significant at least at the 10% level. The coefficients for the openness measure are insignificant as in the baseline regressions, and their signs display the same pattern.

The second robustness check addresses the instruments proliferation bias problem. Roodman (2009b) argues that when too many instruments are used, the Hansen J-test for instrument validity becomes unreliable. In tables 1 and 2 we have addressed this issue by collapsing the instruments matrix. An alternative approach pursued in table 3 is to only use the first lags as instruments.

The estimation results in table 3 are based on the same models as in tables 1 and 2. Overall, the estimation results are once again similar to the baseline regressions. We find that the KOF-Index indicates a positive effect of globalization on secondary and tertiary education expenditures and a negative effect on primary education expenditures in both industrialized and developing countries. In this set of regressions, the coefficients for the KOF-Index in the primary education expenditures model are even significant for both industrialized and developing countries. The signs are similar when the openness measure is used, but the coefficients continue to be insignificant. Nevertheless, the results suggest that globalization increases secondary and tertiary education expenditures in both industrialized and developing countries. They also suggest – with less ambiguity than the previously reported regressions – that globalization reduces primary education expenditures in both industrialized and developing countries as the estimated coefficient for globalization is consistently negative in the relevant regressions.

The third and final robustness check replaces the denominator of the dependent variables (GDP) with total education expenditures. Analyzing the implications of globalization for expenditures for primary, secondary, and tertiary education relative to total education expenditures allows us to ascertain how globalization affects governments' educational priorities.

Table 2: Robustness check I: Two-step standard errors with Windmeijer-correction

Dependent variable	Primary educ. exp.	Secondary educ. exp.	Tertiary educ. exp.	Primary educ. exp.	Secondary educ. exp.	Tertiary educ. exp.
	KOF - Globalization Index			**Openness (Penn World Tables)**		
KOF-Index × IND	-0.009*	0.010*	0.006**			
	(-1.710)	(1.913)	(2.092)			
KOF-Index × DEV	-0.008	0.010*	0.007**			
	(-1.557)	(1.863)	(2.060)			
Openness × IND				-0.001	0.001	0.001
				(-0.611)	(0.778)	(1.580)
Openness × DEV				0.001	0.001	0.001
				(0.461)	(1.076)	(1.605)
Additional controls	yes	yes	yes	yes	yes	yes
N	529	523	530	544	536	546
χ^2	119.147	604.667	560.525	212.909	776.717	682.641
Hansen-test (p-val.)	0.437	0.344	0.654	0.244	0.377	0.323
AR(1)-test (p-val.)	0.233	0.101	0.028	0.156	0.097	0.004
AR(2)-test (p-val.)	0.500	0.231	0.297	0.995	0.234	0.295
Instruments No.	33	36	37	33	36	37

[1] This table presents results for the globalization variables a robustness check where two-step standard errors with the Windmeijer-correction (instead of one-step robust standard errors) are used for hypothesis tests. The specification is otherwise identical to that reported in table 1. Full results are available upon request.
[2] Stars indicate significance levels at 10% (*), 5% (**) and 1%(***)
[3] z-statistics in parentheses
[4] Year fixed effects included in all models
[5] The p-values for the Hansen overidentification test, the p-values for the Arellano-Bond AR(1) and AR(2) tests, and the number of instruments are reported at the bottom of the table
[6] Hypothesis tests are based on one-step robust standard errors
[7] The GMM-style instruments set has been collapsed

As discussed further above, it is possible that high-skilled individuals benefit to some extent from primary education. This effect would tend to limit any reduction in primary education expenditures even if returns to high-skilled individuals have increased and returns to low-skilled individuals have declined due to globalization and the government is interested in maximizing national income. Consequently, analyzing only spending as share of GDP might result in a distorted picture of the shift in the government's educational priorities (i. e. one that under-values the reduction in the importance that the government attaches to primary education).

Table 3: Robustness check II: Restricted lag length

Dependent variable	Primary educ. exp.	Secondary educ. exp.	Tertiary educ. exp.	Primary educ. exp.	Secondary educ. exp.	Tertiary educ. exp.
	KOF - Globalization Index			**Openness (Penn World Tables)**		
KOF-Index × IND	-0.003**	0.008***	0.003***			
	(-1.966)	(2.666)	(3.202)			
KOF-Index × DEV	-0.003**	0.009***	0.003***			
	(-2.259)	(2.865)	(2.763)			
Openness × IND				-0.000	0.000	0.000
				(-1.176)	(0.625)	(1.408)
Openness × DEV				-0.000	0.001	0.000
				(-0.280)	(1.146)	(0.795)
Additional controls	yes	yes	yes	yes	yes	yes
N	529	523	530	544	536	546
χ^2	2354.022	1364.868	3881.607	2466.357	1213.209	3747.386
Hansen-test (p-val.)	0.200	0.459	0.317	0.165	0.383	0.334
AR(1)-test (p-val.)	0.000	0.055	0.001	0.000	0.039	0.001
AR(2)-test (p-val.)	0.972	0.188	0.314	0.689	0.175	0.307
Instruments No.	39	48	48	39	48	48

[1] This table presents results for the globalization variables from a robustness checks where the lag length of the GMM-style instruments for the lagged dependent variable is limited to 1. The specification is otherwise identical to that reported in table 1. Full results are available upon request.
[2] Stars indicate significance levels at 10% (*), 5% (**) and 1%(***)
[3] z-statistics in parentheses
[4] Year fixed effects included in all models
[5] The p-values for the Hansen overidentification test, the p-values for the Arellano-Bond AR(1) and AR(2) tests, and the number of instruments are reported at the bottom of the table
[6] Hypothesis tests are based on one-step robust standard errors
[7] The GMM-style instruments set has been collapsed

Table 4 summarizes the results for these additional estimations.[20] Note that the estimated coefficients are consistent with the baseline results and that their statistical significance is higher. Both the regressions with the KOF-Index and the openness measure suggest that globalization reduces the share of primary education expenditures and increases the share of secondary and tertiary education expenditures. For the KOF-Index regressions, the coefficients are always highly significant. When the openness measure is used, two of the six coefficients are significant as well. Overall, this robustness check indicates once more that the educational priorities of governments in both the industrialized and the developing world

[20] The specification of these models is largely identical to that described in equation 13. The only difference is that for each spending category, all three enrollment shares are simultaneously included since relative spending is analyzed. Full results are available upon request.

Table 4: Robustness check III: Education expenditures for primary, secondary, and tertiary education relative to total education expenditures

Dependent variable	Primary educ. exp.	Secondary educ. exp.	Tertiary educ. exp.	Primary educ. exp.	Secondary educ. exp.	Tertiary educ. exp.
	KOF - Globalization Index			**Openness (Penn World Tables)**		
KOF-Index × IND	-0.179**	0.126**	0.130***			
	(-2.410)	(2.222)	(2.962)			
KOF-Index × DEV	-0.182**	0.137**	0.122***			
	(-2.454)	(2.398)	(2.693)			
Openness × IND				-0.025*	-0.000	0.019*
				(-1.733)	(-0.040)	(1.917)
Openness × DEV				-0.013	-0.000	0.007
				(-1.558)	(-0.034)	(0.795)
Additional controls	yes	yes	yes	yes	yes	yes
N	457	465	535	470	478	551
χ^2	500.011	258.193	386.443	583.361	256.829	565.534
Hansen-test (p-val.)	0.774	0.411	0.811	0.847	0.230	0.807
AR(1)-test (p-val.)	0.028	0.002	0.012	0.020	0.002	0.004
AR(2)-test (p-val.)	0.269	0.643	0.215	0.271	0.737	0.304
Instruments No.	35	37	37	35	37	37

[1] This table presents results for the globalization variables a robustness check where where expenditures for primary, secondary, and tertiary education relative to total education expenditures (instead of expenditures relative to GDP) are used as dependent variables. The specification is mostly identical to that reported in table 1, the only exception is that the three enrollment variables are jointly included in all regressions. Full results available upon request.
[2] Stars indicate significance levels at 10% (*), 5% (**) and 1%(***)
[3] z-statistics in parentheses
[4] Year fixed effects included in all models
[5] The p-values for the Hansen overidentification test, the p-values for the Arellano-Bond AR(1) and AR(2) tests, and the number of instruments are reported at the bottom of the table
[6] Hypothesis tests are based on one-step robust standard errors
[7] The GMM-style instruments set has been collapsed

have shifted because of globalization: primary education has become less important while higher education has become more important.

6 Conclusion

In this paper, we first derived theoretically that globalization affects public education expenditures through two separate channels. On the one hand, globalization changes the wages for different types of labor. This effect incentivizes governments to spend more on higher education. On the other hand, globalization influences education expenditures via the equilibrium tax rate. We derived that if the government is benevolent, globalization will result in higher

expenditures for those educational programs for which returns increase. However, when the government is a Leviathan, the implications of globalization on education expenditures cannot be predicted theoretically. We conclude that the relationship between globalization and public spending for different types of education is an empirical matter.

We therefore explored in a second step the effect of globalization on public expenditures for primary, secondary, and tertiary education empirically with data from 104 countries over the 1992 - 2006 period. The estimation results suggest that globalization has led, relative to GDP and relative to total education expenditures, to lower spending for primary and higher spending for secondary and tertiary education in both industrialized and developing countries.

It is clear that educational policies have distributional consequences by affecting the incomes of individuals. Real-world governments have a wider set of goals than maximizing national income or tax revenues, among which distributional equity is presumably one of the more important ones. The fact that globalization shifts educational priorities toward higher education may therefore be perceived as problematic. As argued previously, students from socio-economically disadvantaged backgrounds benefit predominantly from primary education expenditures, while students with a wealthy background benefit from tertiary education expenditures. Thus, the effects of globalization on public education expenditures identified in this paper may widen the gap between rich and poor in the long-run.[21] Consequently, governments may want to develop strategies to counteract this potential source of inequality in order to sustain support for economic openness.

While this paper provides insights on the relationship between globalization and educational policies, its scope is limited to public education expenditures. This paper can therefore be extended in several ways. First, the interactions between globalization and private education expenditures could be analyzed in more detail given that private educational institutions play an important role in many countries. Second, it might be worthwhile to investigate whether globalization and related processes such as immigration have led to institutional reforms of public education systems, such as the extent to which academic tracking takes place (Hanushek and Woessmann, 2006), and whether such reforms have been successful in addressing the educational challenges due to globalization. Extending this paper along these lines is therefore a promising avenue for future research.

[21] Note that this result is in line with the existing evidence for globalization's aggravating influence on income inequality (Bergh and Nilsson, 2010). In a similar vein, Hessami (2011) provides evidence that globalization has increased the well-being of high-income earners more than that of low-income earners.

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Table A.1: Summary Statistics, definitions, and data sources

Variable		Mean	Std. dev.	Min	Max	Obs	Definition	Source
Primary education expenditures/GDP	overall	1.58	0.73	0.33	5.65	544	Primary education exp.	World Bank Edstats
	between		0.84	0.49	5.57	88	as a share of GDP	database
	within		0.26	0.34	2.91	6.18		
Secondary education expenditures/GDP	overall	1.87	0.73	0.18	5.64	536	Secondary education exp.	World Bank Edstats
	between		0.75	0.19	4.43	85	as a share of GDP	database
	within		0.28	0.78	3.08	6.31		
Tertiary education expenditures/GDP	overall	1.05	0.55	0.14	5.07	546	Tertiary education exp.	World Bank Edstats
	between		0.53	0.14	2.99	87	as a share of GDP	database
	within		0.23	-0.13	3.14	6.28		
KOF-Index	overall	66.40	14.99	27.44	92.14	646	KOF-Index of globalization	Dreher, 2006
	between		14.62	29.40	90.89	100		
	within		4.69	43.68	78.60	6.46		
Openness	overall	80.79	39.51	16.64	210.27	664	(Exports + Imports)/GDP	Penn World Tables 6.3
	between		38.19	22.90	195.33	104	in constant prices	
	within		12.41	26.45	133.57	6.38		
Primary enrollment	overall	103.27	10.90	27.85	154.62	664	Primary gross enrollment	World Bank Edstats
	between		13.35	28.15	146.70	104	ratio	database
	within		4.01	83.47	133.26	6.38		
Secondary enrollment	overall	86.50	27.94	6.35	161.78	647	Secondary gross enrollment	World Bank Edstats
	between		30.47	6.43	148.68	104	ratio	database
	within		5.98	57.71	112.07	6.22		
Tertiary enrollment	overall	38.98	23.93	1.00	93.68	587	Tertiary gross enrollment	World Bank Edstats
	between		22.91	1.17	79.41	98	ratio	database
	within		9.42	3.55	90.49	5.99		
GDP per capita	overall	15.39	11.39	0.59	47.25	664	PPP-adjusted real GDP	Penn World Tables 6.3
	between		10.77	0.62	42.90	104	per capita in thousands	
	within		2.29	2.99	25.93	6.38		
Internet users	overall	17.37	22.03	0	85.90	664	Internet users per 100 people	World Development
	between		14.35	0.00	55.03	104		Indicators
	within		15.86	-32.56	56.72	6.38		
Democracy	overall	2.53	2.04	1	7	664	Index of political rights	Freedom House
	between		2.13	1	7	104	scaled from 1 = most free,	
	within		0.43	0.36	6.03	6.38	7 = least free	
Government ideology	overall	0.36	0.48	0	1	664	Index of government ideology	Own construction based
	between		0.40	0	1	104	regarding economic policy	on DPI (Beck et al., 2001)
	within		0.31	-0.54	1.22	6.38	(left-wing = 1, else = 0)	
Primary education expenditures/TOT	overall	30.56	10.33	13.16	74.36	470	Primary education exp.	World Bank Edstats
	between		11.28	14.76	69.47	76	as a share of total	database
	within		3.57	14.29	49.01	6.18	education exp.	
Secondary education expenditures/TOT	overall	37.44	8.82	9.13	57.67	478	Secondary education exp.	World Bank Edstats
	between		8.91	9.25	54.84	75	as a share of total	database
	within		4.23	9.98	53.14	6.37	education exp.	
Tertiary education expenditures/TOT	overall	19.92	6.63	4.24	36.82	551	Tertiary education exp.	World Bank Edstats
	between		6.42	4.74	35.00	87	as a share of	database
	within		3.18	1.33	32.68	6.33	total education exp.	

[1] The number of observations reported here is larger than in the regression tables because our estimations include lagged variables.

Table A.2: Countries included in the sample

Argentina	Ecuador	Laos	Portugal (I)
Australia (I)	El Salvador	Latvia	Romania
Austria (I)	Eritrea	Lebanon	Russia
Azerbaijan	Estonia	Lesotho	Samoa
Bahrain	Finland (I)	Lithuania	Senegal
Belarus	France (I)	Macedonia	Slovak Republic (I)
Belgium (I)	Gambia, The	Madagascar	Slovenia
Belize	Germany (I)	Malaysia	South Africa
Bolivia	Greece (I)	Maldives	Spain (I)
Brazil	Guatemala	Mauritius	St. Lucia
Bulgaria	Guyana	Mexico (I)	Swaziland
Burundi	Hungary (I)	Mongolia	Sweden (I)
Cambodia	Iceland (I)	Morocco	Syria
Cameroon	India	Namibia	Tajikistan
Canada (I)	Indonesia	Nepal	Thailand
Cape Verde	Iran	Netherlands (I)	Togo
Chad	Ireland (I)	New Zealand (I)	Trinidad &Tobago
Chile	Israel	Nicaragua	Tunisia
China	Italy (I)	Niger	Turkey (I)
Colombia	Jamaica	Norway (I)	Ukraine
Costa Rica	Japan (I)	Oman	United Arab Emirates
Cote d'Ivoire	Kazakhstan	Panama	United Kingdom (I)
Cuba	Kenya	Paraguay	United States (I)
Cyprus	Korea, Republic of (I)	Peru	Uruguay
Czech Republic (I)	Kuwait	Philippines	Vanuatu
Denmark (I)	Kyrgyzstan	Poland (I)	Zambia

[1] This table lists all countries that are included in at least one of the estimated models
[2] Countries classified as "industrialized" are indicated with an "I" in parentheses (see footnote 18 for an explanation of the criteria according to which a country is classified as developing or industrialized)