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# Globalization and the Composition of Public Education Expenditures: A Dynamic Panel Analysis

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## Abstract

This paper studies the relationship between globalization and the composition of public education expenditures. The theoretical model is embedded in a median voter setting and is based on the assumption that globalization leads to lower tax revenues as well as an increase in the relative wage of high-skilled workers. Overall, the theoretical discussion suggests that globalization induces a shift from primary to tertiary education expenditures, which is backed up by empirical evidence from dynamic panel estimations for 121 countries over the 1992 - 2006 period. A possible implication of the shift in educational priorities towards higher education is an increase in income inequality.

**Keywords:** Globalization, public education expenditures, educational policy

**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. However, the true 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).<sup>1</sup> An alternative explanation for the concentration of globalization research in the political economy literature is the content of this research focusing on the vices and virtues of globalization's influence on public policy. More specifically, many contributions investigate 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 Jinjara, 2009; Dreher, 2006b; Hines and Summers, 2009). This includes the question 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 very enlightening, it should not be overlooked that labor nowadays also more easily transcends national borders, albeit not as much as capital. In this context, one may wonder whether governments have adjusted the composition of education expenditures given that especially high-skilled labor is considered to be mobile (Docquier and Marfouk, 2006; Egger and Radulescu, 2009; Grogger and Hanson, forthcoming).

Following such considerations, this paper investigates the effect of globalization on the composition of public education expenditures. First, we derive in a median voter setting that governments' 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) the domestic tax rate. On the one hand, governments have an incentive to invest more resources in tertiary education if globalization increases the wages of high-skilled workers. This would lead to a larger tax base and as a result the median voter would receive more transfer payments. On the other hand, globalization intensifies tax competition and thereby diminishes governments' ability to finance generous transfers to the median voter. From this perspective, it is likely that governments reduce funding for educational programs that do not directly benefit the median voter such as higher education. The overall effect identified

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<sup>1</sup>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, respectively.

in the theoretical discussion is, however, that governments spend less on primary *relative* to tertiary education with a higher level of global economic integration.

Since the theoretical discussion suggests the existence of two effects that go in opposite directions, the net effect of globalization on the government's educational priorities is clearly an empirical matter, which is addressed in the second part of the paper. The dynamic panel analysis is based on System GMM estimations and uses data for 121 countries over the 1992 - 2006 period. The estimation results reveal that globalization has induced governments in developed as well as developing countries to increase spending for tertiary relative to primary education. Most likely, students from socio-economically disadvantaged backgrounds benefit predominantly from primary education expenditures, while students with a wealthy background benefit from tertiary 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.<sup>2</sup>

While the shift in educational priorities towards higher education reduces equity, the effect from an efficiency point of view is ambiguous.<sup>3</sup> In the context of our theoretical model, the allocation of more public resources to higher education is optimal from the viewpoint of the government since it seeks to be re-elected and therefore maximizes the welfare of the median voter. However, if one regards this issue more broadly from an efficiency perspective, additional insights are gained. On the one hand, there is evidence for developing countries that 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 and Verspoor, 1991; Psacharopoulos, 1985).<sup>4</sup> This would suggest that the observed shift in educational priorities is inefficient. On the other hand, a higher share of tertiary education expenditures can be justified from an efficiency perspective by pointing out 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 briefly reviews the existing literature on the linkages between globalization and education expenditures. In section 3, we discuss the relationship between globalization and public expenditures for primary, secondary, and tertiary education in the context of a theoretical model. Section 4 presents the data and the empirical strategy, while we explore the effect of globalization on the composition of public education expenditures empirically in section 5. Section 6 concludes the analysis.

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<sup>2</sup>Wälde (2000) explains the positive 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.

<sup>3</sup>For a distinction between competitiveness-, finance- and equity-driven educational reforms due to globalization see Carnoy (1999).

<sup>4</sup>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.

## 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.<sup>5</sup> The sociological and pedagogical literature primarily analyze how globalization affects structural aspects of public education systems. More specifically, the main questions that are investigated are whether globalization leads to a convergence of nationally diverse educational systems (Green, 1999), whether it causes a “commodification”<sup>6</sup> of education (Naidoo and Jamieson, 2005), and whether it increases the influence of international organizations on educational systems, especially 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 there are many of these measures. Hence, an analysis that is intended to analyze 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 within the fields of economics and political science. 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 these high-income earners. The reduction of the tax base has in turn an influence on public education expenditures.

One example for the tax competition approach is a study by Anderson and Konrad (2003) 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 have the ability to emigrate if the domestic tax-rate is too high. The authors derive that, in general, it cannot be determined whether globalization induces the government to decrease the private costs of education. This would suggest that there is no theoretical link between globalization and total education expenditures.

A second contribution comes from Haupt and Janeba (2009) who assume that the government seeks to redistribute income from high- to low-skilled individuals. The income redis-

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<sup>5</sup>For an overview of recent research on the relationship between globalization on education that covers several academic disciplines see Spring (2008).

<sup>6</sup>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.

tribution is indirectly achieved by 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 become larger. 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. This provides the government with an incentive to reduce total education spending in an increasingly globalized world.

Poutvaara (2008) provides an extension to the two studies mentioned above by making a distinction between different subjects that are taught in higher education institutions. He 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 changed the share of education expenditures in total public expenditures. In contrast, Avelino et al. (2005) find that trade openness was positively related to education spending in Latin America during the 1980 - 1999 period. Busemeyer (2007) uses trade openness as a control variable in a panel data study on the influence of partisan politics on education expenditures in 21 OECD countries. He finds that total education expenditures were positively related to openness during the nineties, and that globalization has increased expenditures for all stages of education, but primarily for tertiary education. Shelton (2007) tests a large number of determinants of public education expenditures simultaneously in order to avoid omitted variable bias. His analysis provides evidence that globalization does not have an effect on public education expenditures. One reason why most of these studies fail to identify a significant effect of global economic integration on educational policies is that these effects can only be observed at lower levels of aggregation.

The second strand of the theoretical literature emphasizes the implications of increased trade on wages for low- and high-skilled labor and discusses how this distortion in wages affects educational policies. This perspective allows for an analysis of globalization's influence on the composition of education expenditures rather than aggregate spending on education. A study by Ansell (2008), as the only theoretical contribution on this question, 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 develop-

ing 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 large number of studies that refute the Heckscher-Ohlin theorem with regard to globalization's predicted influence on wages (Feenstra and Hanson, 1999; Goldberg and Pavenik, 2007), the theoretical foundation for Ansell's findings is rather weak.

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 *total* education expenditures while neglecting potential effects on the composition of education expenditures. The only study analyzing globalization's influence on the composition of public education expenditures that we know of 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 exclusively based on a cross-sectional investigation.

The contribution of our paper is that we address each of the aforementioned shortcomings. First, we derive a theoretical model that emphasizes increased tax competition due to global economic integration, while also taking into account globalization's effect on wages as identified in the empirical literature. Second, we apply the theoretical model in order to investigate globalization's influence on the shares of primary, secondary and tertiary education. In this context, we make use of the common assumption that high-skilled individuals are more mobile than low-skilled individuals. Third, we conduct our estimations with panel data and apply dynamic estimation techniques in order to make use of the variation over time in our dataset. Fourth, we use the shares of primary, secondary and tertiary education as dependent variables rather than total education expenditures.

## 3 Theoretical model

### 3.1 Individuals

In a country with a population mass of unity, a generic individual  $i$  disposes of an exogenously given ability  $\beta_i$  that qualifies her for a certain type of labor. The wage that this individual earns for one unit of (effective) labor amounts to  $w_i$ , while there is a strictly positive relationship between ability and wages, i. e.,  $w_i = w_i(\beta_i)$  with  $dw_i/d\beta_i > 0$ .

The effective labor supply  $p_i$  of an individual  $i$  depends on the amount of public expenditures  $g_i$  the government invests in her education. More specifically, we assume that  $p_i = p_i(g_i)$  with  $dp_i/dg_i > 0$ ,  $d^2p_i/dg_i^2 < 0$ , and  $dp_i/dg_{-i} = 0$ . Public education expenditures are therefore assumed to be productivity-enhancing.

Based on these considerations, individual  $i$ 's market income  $\nu_i$  can be specified as:

$$\nu_i(w_i, g_i) = w_i p_i(g_i), \quad (3.1)$$

with  $d\nu_i/dw_i > 0$ ,  $d\nu_i/dg_i > 0$ , and  $d^2\nu_i/dg_i dw_i > 0$ . In other words, increasing wages and an increasing effective productivity because of increased funding for education raise the market income of individual  $i$ . Moreover, the cross derivative of income with respect to wages and education expenditures is positive.

### 3.1.1 Consumption

In addition to the market income described in equation 3.1, an individual's consumption level is determined by her tax rate and the redistributive transfers she might receive. We assume that every individual is faced with a proportional tax rate  $t$ , while the redistributive transfers are only paid to the median voter. Moreover, in contrast to the tax rate, public education expenditures  $g_i$  may vary between individuals.

As a result, the net-consumption  $y_i$  of a generic individual  $i$  can be expressed as:

$$y_i = (1 - t)\nu_i(w_i, g_i). \quad (3.2)$$

In comparison, the net-consumption of the median voter amounts to:

$$y_m = (1 - t)\nu_m(w_m, g_m) + r, \quad (3.3)$$

where  $r$  denotes the transfer paid to the median voter.

### 3.1.2 Emigration

In a world with global economic integration, the government has to take into account that high-income individuals may emigrate if the tax burden is relatively high.<sup>7</sup> To model an individual’s mobility decision, we presume that the government can commit to a tax rate but not to an allocation of expenditures. An individual therefore only takes the tax rate into account when deciding on whether to emigrate or not.

She will remain in the home country if the following condition holds:

$$(1 - t)w_i + \epsilon_i \geq (1 - t^F)w^F - x, \quad (3.4)$$

with  $t$  denoting the domestic tax rate and  $w_i^F$  and  $t^F$  representing the wage and tax rate in case the individual emigrates to another jurisdiction (the “foreign” wage and tax rate). Moreover,  $x$  denotes the mobility costs, i.e. the costs that are incurred in the case of emigration (will be discussed in more detail in section 3.4.2), while  $\epsilon_i$  is a random parameter measuring the home attachment of individual  $i$  with  $\epsilon \sim U(0, b)$ . Individual  $i$  will emigrate if the sum of her net-wage and the home attachment is larger than the net-wage she would earn in the foreign country minus the mobility costs. For simplicity, we treat in the following the foreign tax rate and the foreign wage as exogenously given and fixed.

Given that  $\epsilon_i$  is random, individual  $i$ ’s mobility decision is stochastic. The probability  $\pi_i$  that individual  $i$  will remain in the country can be expressed as a function of the domestic tax rate, the domestic wage, and the mobility costs:

$$\pi_i(t, w_i, x) = F(\epsilon \geq z) = 1 - \frac{1}{b}z, \quad (3.5)$$

with  $z = (1 - t^F)w^F - (1 - t)w_i - x$ ,

$$d\pi_i/dt = -\frac{1}{b}w_i < 0,$$

$$d\pi_i/dx = \frac{1}{b} > 0,$$

and  $d\pi_i/dw_i = (1 - t) > 0$ .

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<sup>7</sup>The assumption that the production factors are supplied endogenously implies an alternative tax base effect. We ignore this effect in order to keep the model tractable. A second concern with the above assumptions is that not only high- but also low-skilled individuals may respond to fiscal-policy incentives. However, there is evidence that the high-skilled are in this regard more mobile than the low-skilled (Docquier and Marfouk, 2006; Egger and Radulescu, 2009; Grogger and Hanson, forthcoming). Moreover, given that several countries implement “quality-selective” immigration policies and actively discourage low-skilled migration into welfare state institutions by legal barriers, it is probably reasonable to assume that fiscal policies are rather used to attract and retain high-skilled than to “ward off” low-skilled immigrants.

### 3.2 The government

The government seeks to be re-elected and is therefore exclusively concerned with the consumption possibilities of the median voter  $i = m$ .<sup>8</sup> The government's objective function is set up accordingly:

$$\max_{g_i, t, r} W = (1 - t)\nu_m(w_m, g_m) + r \quad (3.6)$$

with  $g_i \geq 0, t \geq 0, r \geq 0$ .

The government has to ensure that expenditures do not exceed revenues when maximizing the above objective function, while in turn both of these variables depend on the tax rate the governments chooses. The balanced budget constraint can in summary be expressed as:

$$\int_0^1 \left( \pi_i(t, w_i, x) t \nu_i(w_i, g_i) - g_i \right) di - r = 0 \quad (3.7)$$

Thus, the income of the other individuals is only of interest to the government as far as it leads to higher transfers to the median voter.

### 3.3 Equilibrium

In the following, concentrate on equilibria with strictly positive transfers ( $r > 0$ ) and assume that the median voter remains in the country (she will not emigrate irrespective of any wage differentials). Our objective is to derive expressions for the government's three decision variables in equilibrium: the respective level of education expenditures, the tax rate, and the redistributive transfers. We start with the equilibrium education expenditures for the median voter which can be expressed as:

$$\frac{d\nu_m}{dg_m} - 1 = 0. \quad (3.8)$$

Equation 3.8 states that in equilibrium, the increase in the median voter's income due to a marginal increase in education expenditures is equal to the marginal costs, which are 1.

In comparison, education expenditures for all other individuals are characterized by:

$$t \frac{d\nu_i}{dg_i} - 1 = 0 \quad \forall i \neq m. \quad (3.9)$$

Thus, the increase in tax revenues due to a marginal increase in education expenditures should be equal to the costs, which are 1.

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<sup>8</sup>The idea that governments maximize the median voter's utility was originally introduced by Black (1948) and Downs (1957) to illustrate the stylized fact that electoral competition between political parties creates a bias towards centrist policies. We use this idea as the basis of our theoretical model due to its strong empirical support (Congleton and Bennett, 1995; Congleton and Shughart, 1990; Poole and Daniels, 1985).

The second decision variable of the government, which applies to all individuals including the median voter, is the equilibrium tax rate, which can be represented by the following expression:

$$-\nu_m + \int_0^1 \left( \frac{d\pi_i}{dt} t\nu_i + \pi_i \nu_i \right) di = 0. \quad (3.10)$$

Hence, the equilibrium tax rate is characterized by the fact that the emigration-induced expected decrease in tax revenues when the tax rate is raised marginally is slightly outweighed (that is, by  $\nu_m$ ) by the increase in revenues.

The third decision variable of the government, i.e. the amount of redistributive transfers  $r$  in equilibrium, is determined residually as total revenues minus total education expenditures.

### 3.4 Globalization

In the following, we analyze how globalization affects the equilibrium characterized by equation (3.8)-(3.10). Globalization has two effects in the context of this model as global economic integration affects wages (section 3.4.1) and reduces the costs of mobility (section 3.4.2).

#### 3.4.1 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 as the central contributions on this topic state that falling trade restrictions lead to an equalization of factor prizes through an increase in the trade of final goods (Krugman and Obstfeld, 2005).

As an extension to the discussion in section 3.1, we therefore model the wage of a generic individual  $i$  as a function of her ability  $\beta_i$  as well as globalization  $G$ , i. e.:

$$w_i = w_i(\beta_i, G). \quad (3.11)$$

How does globalization affect the wage for individual  $i$  or put differently, what is the sign of  $dw_i/dG$ ? According to the Heckscher-Ohlin model, the sign of this expression will depend on (i) the skill level of individual  $i$  and (ii) the development status of the country that the individual lives in. Given that industrialized countries have a relative abundance in high-skilled labor, while developing countries face a relative abundance in unskilled labor, one implication of the Heckscher-Ohlin model is that the returns to low-skilled labor will increase in developing and decrease in industrialized countries with deepening globalization, and vice versa for high-skilled labor.

The empirical evidence, however, only partially confirms the predictions of the Heckscher-Ohlin model. Several studies suggest that global economic integration has led to a relative rise in wages for high-skilled labor in industrialized countries (Feenstra and Hanson, 1999) *and* developing countries (Goldberg and Pavenik, 2007). Therefore, it is reasonable to assume that  $d^2w_i/d\beta_idG > 0$  for any country irrespective of the country's development status.

### 3.4.2 Mobility costs

The mobility costs  $x$  (see equation 3.4) can be understood as the monetary representation of the difficulty of keeping in touch with one's social and professional networks, and as the pecuniary costs of relocating physical assets. One consequence of global economic integration is certainly a reduction in 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 ongoing spread of English as a modern Lingua Franca and the emergence of a common global culture, both of which might reduce the non-monetary costs of 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  $dx/dG < 0$ .

## 3.5 Globalization and public education

By implicitly differentiating equation (3.8) with respect to  $G$ , we can analyze the effect of globalization on educational expenditures for programs that benefit the median voter:

$$\frac{dg_m}{dG} = - \left( \frac{d^2\nu_m}{dg_m^2} \right)^{-1} \frac{d^2\nu_m}{dg_m dw_m} \frac{dw_m}{dG}. \quad (3.12)$$

The sign of this expression depends only on the sign of  $dw_m/dG$ , i. e., how globalization affects the returns to the type of labor supplied by the median voter. The government increases funding for educational programs that benefit the median voter if the returns to the type of labor that she supplies increase, and vice versa.

The effect of globalization on education expenditures for the remaining individuals is more complicated. Implicitly differentiating equation (3.9) and using the fact that in any equilibrium  $d\nu_i/dg_i = 1/t$  gives:

$$\frac{dg_i}{dG} = - \left( \frac{1}{t} \frac{dt}{dG} + t \frac{d^2\nu_i}{dw_idg_i} \frac{dw_i}{dG} \right) \left( t \frac{d^2\nu_i}{dg_i^2} \right)^{-1}. \quad (3.13)$$

This expression reveals that the effect of globalization on the amount of education expenditure for individual  $i$  works through two distinct channels: (i) its effect on the wage for that type of labor that individual  $i$  supplies and (ii) its effect on the domestic tax rate. The wage effect may vary between individuals. In particular, the sign of  $dw_i/dG$  is likely to differ between high-skilled and low-skilled individuals. The available empirical evidence indicates that  $dw_i/dG$  is positive for high-skilled and negative for low-skilled individuals in both industrialized *and* developing countries. Thus, this effect of globalization should incentivize governments to increase expenditures for higher educational programs and reduce expenditures for basic education.

On the other hand, the tax effect on education expenditures is the same for all  $i \neq m$ . However,  $t$  is an endogenous variable so that the sign of  $dt/dG$  has to be determined within the system. It is unclear whether it will be positive or negative. Implicitly differentiating equation (3.10) reveals that globalization has two effects on the domestic tax rate (see appendix A for the derivation). First, it changes individual  $i$ 's probability of emigration. Second, it has an effect on incomes, a direct one through its effect of wages and an indirect one through its effect on education expenditures. Intuitively, if globalization increases gross income, then the tax base increases and the government has an incentive to raise the domestic tax rate. On the other hand, by decreasing mobility costs, globalization provides governments with an incentive to lower the domestic tax rate in order to limit emigration.

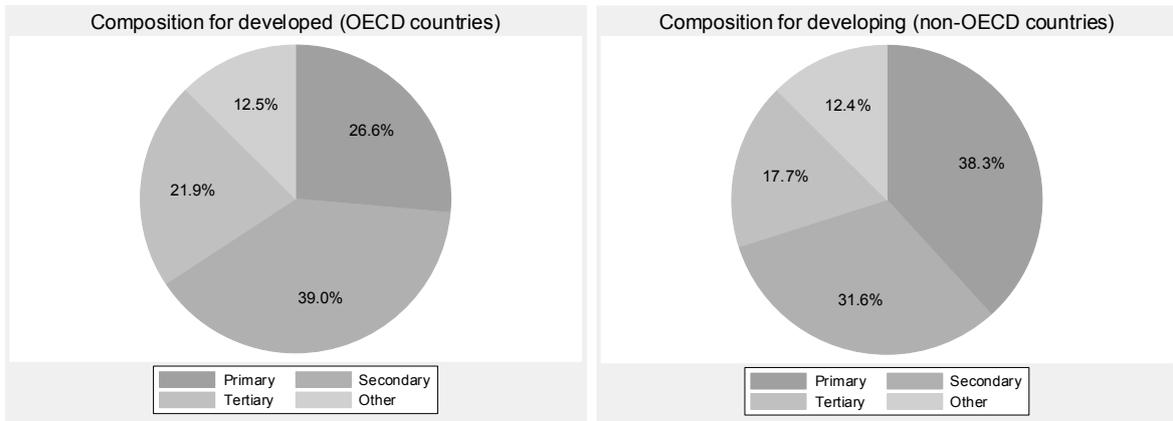
Especially because of its indeterminate effect on the tax rate, the effect of globalization on *absolute* education expenditures is ambiguous. However, the previous discussion of the wage effects of globalization suggests that globalization induces governments in industrialized and developing countries to increase expenditure for higher educational programs *relative* to lower educational programs. We test this implication of our model in the next section empirically on the basis of the composition of public education expenditures.

## 4 Data and methodology

### 4.1 Data description

The education expenditure data is obtained from the World Bank's Edstats database, where the original source for this data is the UNESCO Institute of Statistics. 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 pie charts illustrate to what extent the allocation of education expenditures on average differs between these two country groups.

**Figure 1:** COMPOSITION OF PUBLIC EDUCATION EXPENDITURES, 1992 - 2006



Source: World Bank Edstats database

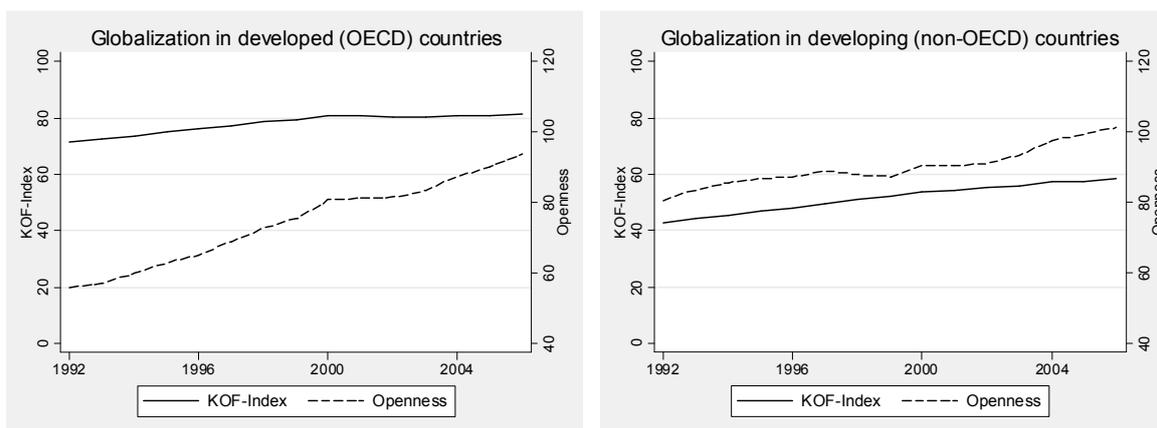
Figure 1 suggests that OECD countries spend a smaller share of total education expenditures (26.6%) on primary education than developing countries (38.3%). This can be attributed to the fact that the average level of education is lower in developing countries with a large share of the population only receiving basic education. This difference in education levels is also confirmed with regard to the shares of secondary and tertiary education expenditures. While OECD countries spend on average 39.0% and 21.9% of the funds available for education on secondary and tertiary education, these shares only amount to 31.6% and 17.7% in developing countries, respectively.

To measure globalization, we use two proxies: the KOF-Index introduced by Dreher (2006a) and the trade openness measure (openness 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. The overall index of globalization is therefore based on a number of measures that capture actual economic flows, economic restrictions, data on information flows, data on personal contact, and data on cultural proximity. The KOF-Index may therefore provide 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 check for the robustness of the results. The evolution of the country-averages of these two measures of globalization from 1992 onwards is plotted separately for developed and developing countries in figure 2.

Both the KOF-Index and the trade openness measure on average suggest increasing globalization for the two country groups, while the trade openness measure exhibits more variation over time than the KOF-Index. Moreover, 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 much more dependent

on international trade. In contrast, the KOF-Index is generally by about 20 points higher in developed than in developing countries, which may imply that for instance in terms of cultural proximity and information flows wealthy countries are more globalized. The differences between the two globalization measures are the reason why we choose to use both of them in our regression analysis.

**Figure 2:** EVOLUTION OF GLOBALIZATION OVER TIME, 1992 - 2006



Sources: Penn World Tables and Dreher (2006a)

The first control variable that we include is the dependent variable lagged by one period in order to capture dynamic effects in the composition of public education expenditures. Further control variables are: (i) the population share of each of the age groups relevant for the three educational programs, which represent the “theoretical demand” for the three types of education expenditures; (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, which controls for systematic partisan biases in education expenditures; and (iv) an index of democracy, which measures to what extent the government is accountable to the electorate.

We associate individuals aged 5 to 10 years with primary education, individuals aged 11 to 15 years with secondary education, and individuals aged 16 to 24 years with tertiary education. Even though this is only a rough approximation of the theoretical demand as the ages at which the three educational stages begin vary between countries, it should be sufficiently accurate. The ideology variable is a dummy that is 1 when the government is left-wing with respect to economic policy, and else 0.<sup>9</sup> The democracy index is 1 when citizens possess the highest and 7 when they possess the lowest amount of political rights. All control variables and their sources are listed in table 4.

<sup>9</sup>Note that this 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.

The unbalanced dataset covers altogether 121 countries, both developing and developed, over the 1992 - 2006 period.<sup>10</sup> Summary statistics for all variables used in the subsequent regressions are collected in table 5; a list of the countries that are considered in this study can be found in table 6. Both tables are in the appendix.

## 4.2 Empirical strategy

We estimate three dynamic panel data models to analyze the effect of globalization on the composition of public education expenditures. The three models take into account that the overall effect of globalization may differ between developing and industrialized countries. In each of the three cases, the estimation model is specified as follows:

$$\begin{aligned} \text{Expshare}_{it} = & \alpha \text{Expshare}_{i,t-1} + \delta \text{Globalization}_{it} * \text{IND} + \gamma \text{Globalization}_{it} * \text{DEV} \\ & + \beta x_{it} + \omega_t + \lambda_i + \epsilon_{it}, \end{aligned} \tag{4.1}$$

where  $\text{Expshare}_{it}$  is the share of public education expenditures allocated to either primary, secondary, or tertiary education,  $\text{Expshare}_{i,t-1}$  represents the lag of the dependent variable,  $\lambda_i$  are the country fixed effects,  $\omega_t$  are the year fixed effects,  $x_{it}$  represents a vector of control variables, and  $\epsilon_{it}$  is the error term.

Note that analyzing these three expenditure categories simultaneously is not redundant since there are certain education expenditures that cannot be allocated to any of these three categories, so that the shares of primary, secondary, and tertiary education expenditures in total education expenditures do generally not sum up to 100% (see figure 1).

Two variables are used in model 4.1 to explore the effect of globalization in industrialized and developing countries. The first variable is constructed by interacting a measure of globalization with a dummy variable,  $\text{IND}$ , that is 1 for industrialized countries and else 0. The second variable is constructed by interacting the same measure of globalization with a dummy variable,  $\text{DEV}$ , that is 1 for developing countries and else 0. We classify all countries as either industrialized or developing (see table 6).<sup>11</sup> We are interested in the estimates for  $\delta$  and  $\gamma$ , the coefficients on the interaction variables:  $\delta$  measures the effect of globalization in industrialized countries, whereas  $\gamma$  measures its effect in developing countries.

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<sup>10</sup>Since fixed effects are included in the empirical model (4.1), each of the included countries has at least two non-missing observations during the time frame of the analysis.

<sup>11</sup>Any classification of countries as industrialized or developing is of course arbitrary. We classify only OECD countries 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.

Note that we do not include the industrialized and developing country dummies, i.e., the “lower-order” effects of these dummies, as separate control variables in equation 4.1 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.<sup>12</sup>

Due to the presence of the fixed effects and the lagged dependent variable in equation 4.1, pooled OLS estimations are inconsistent. However, it is a well-known fact 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. In order to shed light on the question what a large T means in the given context, Judson and Owen (1999) find that even in panels with  $T = 30$ , the estimated coefficient may have a bias of up to 20% of the true value. Since T is equal to 15 in our dataset, 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, 2009b). Between these two, the choice of the appropriate estimator depends on whether the dependent variable is persistent or not. For persistent dependent variables, there is evidence that 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, 2009a).<sup>13</sup>

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<sup>12</sup>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,  $\beta_2$  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 4.1. Since it is equivalent to the complete specification, the same is true for equation 4.1.

<sup>13</sup>Without collapsing, the instruments count can be as high as 240.

## 5 Estimation results

### 5.1 Baseline regressions

The results for the System-GMM estimations of model 4.1 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 fact that we use three different dependent variables: the share of primary, secondary, and tertiary education spending. The dependent variables represent the expenditures at each of the three education levels divided by total education expenditures.

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 relative to tertiary education in both industrialized and developing countries. The coefficients for the interaction variables, irrespective of whether the KOF-Index or the openness variable is used, is negative in the model for primary and positive in the model for tertiary education expenditures. The coefficients are, with one exception, at least significant at the 10% level and in some cases even significant at the 1% level. Generally, it can be said that the significance levels for the globalization coefficient are higher when using the KOF-index. This is in line with our expectations since it is much more comprehensive than the trade openness measure.

The magnitudes of the estimated effects in industrialized and developing countries are remarkably similar. A one-point increase in the KOF-Index reduces the share of primary education expenditures by around 0.135 percentage points in industrialized and by about 0.141 percentage points in developing countries. At the same time, it increases the share of tertiary education expenditures by 0.112 and by 0.106 percentage points, respectively. A one-point increase in the trade openness measure reduces the share of primary education expenditures by around 0.036 percentage points in industrialized and by about 0.020 percentage points in developing countries, and it increases the share of tertiary education expenditures by 0.013 and by 0.003 percentage points, respectively.

**Table 1:** BASELINE RESULTS: SYSTEM GMM ESTIMATIONS, 1992 – 2006

Dependent variables:	KOF - Globalization Index			Openness (Penn World Tables)		
	Primary education expenditures	Secondary education expenditures	Tertiary education expenditures	Primary education expenditures	Secondary education expenditures	Tertiary education expenditures
Primary education expenditures in $t - 1$	0.419*** (2.959)			0.443*** (3.073)		
Secondary education expenditures in $t - 1$		0.610*** (5.849)			0.608*** (5.759)	
Tertiary education expenditures in $t - 1$			0.455*** (3.724)			0.514*** (3.187)
<b>KOF-Index <math>\times</math> IND</b>	-0.135** (-2.234)	0.013 (0.405)	0.112*** (2.891)			
<b>KOF-Index <math>\times</math> DEV</b>	-0.141** (-2.196)	0.022 (0.671)	0.106*** (2.652)			
<b>Openness <math>\times</math> IND</b>				-0.036** (-2.280)	0.002 (0.206)	0.013* (1.654)
<b>Openness <math>\times</math> DEV</b>				-0.020* (-1.744)	0.005 (0.805)	0.003 (0.525)
Primary population	1.328*** (2.916)	-1.036*** (-3.537)	0.316 (1.525)	1.123*** (2.761)	-0.979*** (-3.631)	0.177 (1.050)
Secondary population	-1.286 (-1.187)	1.961*** (2.822)	-0.841 (-1.431)	-0.437 (-0.449)	1.780*** (2.715)	-0.768 (-1.525)
Tertiary population	0.473 (1.151)	-0.725** (-2.514)	0.241 (1.115)	0.191 (0.530)	-0.583** (-2.206)	0.208 (1.187)
GDP per capita	0.036 (0.599)	-0.021 (-0.524)	0.067 (1.265)	-0.006 (-0.126)	-0.004 (-0.085)	0.104** (2.060)

Democracy	-0.880** (-2.167)	0.385** (1.980)	0.321* (1.729)	-0.519* (-1.663)	0.190 (1.046)	0.162 (1.190)
Government ideology	-1.185 (-1.643)	0.296 (0.591)	0.413 (0.929)	-0.873 (-1.300)	0.148 (0.290)	0.178 (0.422)
Observations	587	650	754	603	666	775
$\chi^2$	767.071	1085.849	418.184	713.561	997.463	473.261
Hansen-test (p-value)	0.809	0.283	0.374	0.849	0.392	0.445
AR(1)-test (p-value)	0.003	0.001	0.000	0.003	0.001	0.000
AR(2)-test (p-value)	0.143	0.808	0.179	0.126	0.849	0.247
Number of instruments	51	53	53	51	53	53

<sup>1</sup> Stars indicate significance levels at 10%(\*), 5%(\*\*) and 1%(\*\*\*) <sup>2</sup> t-statistics are in parentheses <sup>3</sup> Time fixed effects are included in all models

<sup>4</sup> The GMM-style instruments set has been collapsed <sup>5</sup> Hypothesis tests are based on robust one-step standard errors

<sup>6</sup> p-values for the Hansen overidentification test and the Arellano-Bond AR(1) and AR(2) tests as well as the number of instruments are reported at the bottom of the table. <sup>7</sup> Primary, secondary and tertiary education expenditures are measured as a share of total education expenditures

The remaining control variables perform reasonably. The lagged dependent variable is significantly positive with a coefficient between 0.4 and 0.6 for all expenditure categories, suggesting a high degree of persistence in the composition of education expenditures. In addition, we find that there is a positive relationship between the population share relevant for primary and secondary education and expenditures for primary and secondary education, whereas an increase in the population share relevant for tertiary education has no effect on expenditures. This is consistent with the notion that primary and the earlier parts of secondary education are usually compulsory, so that a larger number of children in the age group relevant for these education levels directly increases spending needs.

Another variable that is significant in some models is the democracy index which is consistently negative in the model for primary education and positive in the models for secondary and tertiary education. Taking into account that the democracy index is 1 when citizens possess the highest and 7 when they possess the lowest amount of political rights, we find that *ceteris paribus* more democratic countries spend more on lower relative to higher educational programs. This can be attributed to the fact that a deepening of democracy usually suggests an extension of political rights to the less wealthy part of society. These groups in turn benefit more from primary than from tertiary education.

The coefficient for GDP per capita is insignificant in all models but one. In the regressions using tertiary education expenditures as the dependent variable and openness as a proxy for globalization (last column of table 1), it has a positive coefficient significant at the 5% level. This would suggest that the more wealthy a country is the higher is the share of public resources intended for education that this country allocates to higher education. Finally, the coefficient for government ideology is insignificant suggesting that there are no systematic partisan biases in the allocation of public education expenditures. This is not surprising given that the evidence in favor of partisan biases at higher levels of aggregation of public expenditures is generally quite weak.

## 5.2 Sensitivity analysis

This section provides the results for two robustness checks that are conducted in addition to the fact that we employ two different globalization measures. The estimations in tables 2 and 3 address potential deficiencies of the estimations in table 1 from an econometric viewpoint. 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 is used 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).

**Table 2:** ROBUSTNESS CHECK I: SYSTEM GMM ESTIMATIONS WITH TWO-STEP STANDARD ERRORS, 1992 – 2006

Dependent variables:	KOF - Globalization Index			Openness (Penn World Tables)		
	Primary education expenditures	Secondary education expenditures	Tertiary education expenditures	Primary education expenditures	Secondary education expenditures	Tertiary education expenditures
Primary education expenditures in $t - 1$	0.492*** (4.315)			0.477*** (4.097)		
Secondary education expenditures in $t - 1$		0.595*** (4.639)			0.614*** (4.597)	
Tertiary education expenditures in $t - 1$			0.391*** (3.232)			0.392** (2.462)
<b>KOF-Index <math>\times</math> IND</b>	-0.092 (-1.291)	0.008 (0.193)	0.105*** (2.714)			
<b>KOF-Index <math>\times</math> DEV</b>	-0.085 (-1.170)	0.013 (0.311)	0.102** (2.388)			
<b>Openness <math>\times</math> IND</b>				-0.036** (-2.127)	0.002 (0.222)	0.013 (1.577)
<b>Openness <math>\times</math> DEV</b>				-0.017 (-1.423)	0.005 (0.711)	0.003 (0.437)
Primary population	1.573*** (4.096)	-1.052*** (-2.716)	0.285 (1.356)	1.393*** (3.727)	-0.994*** (-2.855)	0.191 (1.003)
Secondary population	-1.675* (-1.946)	1.603* (1.777)	-0.906 (-1.474)	-1.060 (-1.281)	1.617* (1.868)	-0.874 (-1.481)
Tertiary population	0.437 (1.461)	-0.545 (-1.467)	0.243 (1.000)	0.285 (0.987)	-0.554 (-1.545)	0.198 (0.984)
GDP per capita	0.078 (1.230)	-0.055 (-1.101)	0.086* (1.648)	0.042 (0.859)	-0.039 (-0.718)	0.123** (2.278)

Democracy	-0.764** (-2.404)	0.265 (1.199)	0.345 (1.526)	-0.470* (-1.670)	0.157 (0.712)	0.179 (1.120)
Government ideology	-0.561 (-0.835)	0.001 (0.002)	0.386 (0.840)	-0.717 (-1.094)	0.014 (0.028)	0.292 (0.641)
Observations	587	650	754	603	666	775
$\chi^2$	882.706	1042.405	373.045	850.113	883.511	381.440
Hansen-test (p-value)	0.809	0.283	0.374	0.849	0.392	0.445
AR(1)-test (p-value)	0.017	0.006	0.016	0.016	0.006	0.046
AR(2)-test (p-value)	0.174	0.873	0.173	0.159	0.908	0.238
Number of instruments	51	53	53	51	53	53

<sup>1</sup> Stars indicate significance levels at 10%(\*), 5%(\*\*) and 1%(\*\*\*) <sup>2</sup> t-statistics are in parentheses <sup>3</sup> Time fixed effects are included in all models

<sup>4</sup> The GMM-style instruments set has been collapsed <sup>5</sup> Hypothesis tests are based on two-step standard errors with Windmeijer correction

<sup>6</sup> p-values for the Hansen overidentification test and the Arellano-Bond AR(1) and AR(2) tests as well as the number of instruments are reported at the bottom of the table. The null hypothesis is ..., respectively.

<sup>7</sup> Primary, secondary and tertiary education expenditures are measured as a share of total education expenditures

Generally, we find that the results in table 2 confirm the conclusions drawn with regard to the estimation results in table 1, even though the overall significance of the coefficients is lower. In the regressions using the KOF-Index as a proxy for globalization (columns 2 to 4), the coefficient for globalization is insignificant in the primary education expenditure model, but continues to be significantly positive for tertiary education expenditures. The size of the coefficient is also very similar to the results in table 1. This suggests that expenditures are still shifted towards higher education, even though it is not clear at the cost of which other category this occurs. The coefficient for primary expenditures continues to be negative, even though the t-statistic is now only at around -1.2 to -1.3.

When the trade openness variable is used (column 5 to 7), the coefficient for globalization is less significant than in columns 2 to 4. This coincides with our findings in table 1 and can be explained by the fact that the KOF-Index is the more appropriate and more comprehensive measure. In the regressions based on the trade openness measure, the globalization coefficient is only significantly negative for industrialized countries in the model for primary education expenditures. Hence, according to this measure, globalization does not affect the share of expenditures on primary education in developed countries and the tertiary expenditure share in any of the two country groups. Finally, it should be noted that the signs and levels of significance of the remaining control variables is very similar to the results presented in the baseline estimations.

The second robustness check addresses the instruments proliferation bias problem. Roodman (2009a) argues that when too many instruments are used Sargan and Hansen J-tests used for testing instrument validity become weak and unreliable. In tables 1 and 2 we have already addressed this issue by collapsing the instruments matrix. Another approach would be to only use the first lags as instruments. This is the approach pursued in table 3.

The estimation results in table 3 are based on the same models as in tables 1 and 2. With regard to the estimations using the KOF-Index, we can say that the coefficients for primary and tertiary education expenditures have the same sign and are significant both for developing and developed countries. While the size of the globalization coefficient for primary education expenditures is still at around -0.1, it is by about 50% smaller for tertiary education expenditures compared to the results in table 1. However, the coefficient is still quite large since a 10-point increase in the KOF-Index would lead to an increase in the share of higher education expenditures by 0.6 percentage points.

In columns 5 to 7 (based on the openness measure), only the coefficient for primary education expenditures continues to be significant, while in column 7, the t-statistic for tertiary education expenditures is -1.62, which almost corresponds with significance at the 10% level. Finally, it should be noted that the results for the control variables are again very similar to those in table 1. The only difference that emerges is that the coefficient for GDP per capita is now even insignificant in column 7.

**Table 3:** ROBUSTNESS CHECK II: SYSTEM GMM ESTIMATIONS WITH RESTRICTED LAG LENGTH, 1992 – 2006

Dependent variables:	KOF - Globalization Index			Openness (Penn World Tables)		
	Primary education expenditures	Secondary education expenditures	Tertiary education expenditures	Primary education expenditures	Secondary education expenditures	Tertiary education expenditures
Primary education expenditures in $t - 1$	0.601*** (6.271)			0.586*** (5.681)		
Secondary education expenditures in $t - 1$		0.789*** (11.571)			0.788*** (11.112)	
Tertiary education expenditures in $t - 1$			0.750*** (7.333)			0.738*** (6.453)
<b>KOF-Index <math>\times</math> IND</b>	-0.094** (-2.298)	0.011 (0.485)	0.058** (2.132)			
<b>KOF-Index <math>\times</math> DEV</b>	-0.098** (-2.254)	0.017 (0.818)	0.054* (1.879)			
<b>Openness <math>\times</math> IND</b>				-0.027** (-2.247)	-0.000 (-0.097)	0.008 (1.618)
<b>Openness <math>\times</math> DEV</b>				-0.015* (-1.717)	0.003 (0.836)	0.001 (0.204)
Primary population	0.955*** (2.943)	-0.657*** (-3.402)	0.100 (0.763)	0.876*** (2.923)	-0.641*** (-3.525)	0.069 (0.615)
Secondary population	-0.863 (-1.114)	1.380*** (3.067)	-0.356 (-1.049)	-0.326 (-0.446)	1.302*** (3.033)	-0.442 (-1.358)
Tertiary population	0.282 (0.966)	-0.455** (-2.363)	0.120 (1.053)	0.117 (0.437)	-0.382** (-2.171)	0.127 (1.202)
GDP per capita	0.034 (0.809)	-0.015 (-0.575)	0.028 (0.982)	0.002 (0.065)	-0.003 (-0.127)	0.055 (1.642)

Democracy	-0.579** (-2.103)	0.145 (1.078)	0.191* (1.812)	-0.367 (-1.607)	0.030 (0.256)	0.139* (1.694)
Government ideology	-0.759 (-1.384)	0.300 (0.780)	0.058 (0.205)	-0.618 (-1.155)	0.229 (0.589)	-0.015 (-0.055)
Observations	587	650	754	603	666	775
$\chi^2$	1560.962	2618.706	1524.013	1331.519	2528.220	1232.484
Hansen-test (p-value)	0.159	0.858	0.514	0.191	0.860	0.506
AR(1)-test (p-value)	0.003	0.001	0.000	0.003	0.001	0.000
AR(2)-test (p-value)	0.165	0.880	0.272	0.156	0.912	0.327
Number of instruments	40	48	48	40	48	48

<sup>1</sup> Stars indicate significance levels at 10%(\*), 5%(\*\*) and 1%(\*\*\*) <sup>2</sup> t-statistics are in parentheses <sup>3</sup> Time fixed effects are included in all models

<sup>4</sup> The GMM-style instruments have been restricted to the first lag <sup>5</sup> Hypothesis tests are based on one-step standard errors

<sup>6</sup> p-values for the Hansen overidentification test and the Arellano-Bond AR(1) and AR(2) tests as well as the number of instruments are reported at the bottom of the table. <sup>7</sup> Primary, secondary and tertiary education expenditures are measured as a share of total education expenditures

The estimation results collected in tables 1 to 3 clearly suggest that the share of higher education expenditures has increased due to globalization. Some of the estimation models, especially those in table 1, suggest that this shift in educational priorities has occurred at the expense of primary education expenditures. The effect is larger and more robust in terms of statistical significance when the KOF-Index is used as a proxy for globalization instead of the more traditional trade openness measure. This is not surprising given that the dimensions of globalization captured by globalization coincide more strongly with our theoretical considerations in section 3. It is obvious that an individual's decision to emigrate or not is not affected by trade flows but rather by issues such as cultural proximity, language competencies or the difficulty of obtaining a work permit in a foreign country.

## 6 Conclusion

This paper analyzes whether globalization affects educational policies by studying its effect on the composition of public education expenditures. We first derived theoretically that globalization affects public education expenditures through two separate channels. On the one hand, globalization changes the returns to different types of labor. This effect provides governments with an incentive to increase expenditures for those educational programs for which returns increase more. On the other hand, globalization affects education expenditures through its effect on the equilibrium tax rate. It was, however, not possible to determine the sign of this effect analytically and to derive how globalization affects *absolute* education expenditures. However, the theoretical discussion suggested that governments will spend less on lower *relative* to higher educational programs with increasing globalization.

In a second step, we explored this hypothesis empirically with data on 121 countries over the 1992 - 2006 period. Overall, the results are fairly unambiguous, even though they are less robust when using the trade openness measure as a proxy for globalization rather than the KOF-Index. We find that globalization reduces the share of education expenditures allocated to primary education and increases the share allocated to tertiary education in both developed and developing countries. This paper therefore suggests that globalization, in the long run, increases income inequality due to its effect on educational policies.

During the theoretical discussion in section 3, we assumed that a random fraction of individuals obtains primary degrees for given primary education expenditures. But those who successfully participate in primary education are usually not determined randomly. It is likely that students who originate from richer households will require less public resources to complete primary education because they have a more effective private support network. It will therefore be children from poorer households who will be denied a reasonable primary education if the educational priorities of the government shift due to globalization.

This paper can be extended in several ways. First, one could explore whether absolute expenditures for the different educational programs have been affected by globalization. It is possible that primary education expenditures, while declining as a share of total education expenditures, have increased in absolute amount, and this might mitigate the negative distributional implications to some extent. Second, the interactions between globalization and private education expenditures should be analyzed in more detail given that private educational institutions play a role in many countries. Third, it might be worthwhile to analyze whether globalization has led to institutional reforms of public education systems that affect educational outcomes of disadvantaged children. For example, it is well known that the extent of academic tracking determines educational outcomes (Hanushek and Woessmann, 2006), and globalization may be related to such features of educational systems. Extending this paper along these lines is therefore a promising avenue for future research.

## Appendix A

This appendix derives how globalization affects the domestic tax rate in equilibrium. Implicitly differentiating equation (3.10) gives:

$$-\frac{d\nu_m}{dw_m} \frac{dw_m}{dG} - \frac{d\nu_m}{dg_m} \frac{dg_m}{dG} + \int_0^1 \left( -\frac{1}{b} \frac{dw_i}{dG} t \nu_i - \frac{1}{b} w_i \frac{dt}{dG} \nu_i - \left( \frac{1}{b} w_i t - \pi_i \right) \left( \frac{d\nu_i}{dw_i} \frac{dw_i}{dG} + \frac{d\nu_i}{dg_i} \frac{dg_i}{dG} \right) + \left( -\frac{1}{b} w_i \frac{dt}{dG} + (1-t) \frac{dw_i}{dG} + \frac{1}{b} \frac{dx}{dG} \right) \nu_i \right) di = 0.$$

Note that we have used that  $d^2\pi_i/dt^2 = 0$ ,  $d^2\pi_i/dtdx = 0$ , and  $d^2\pi_i/dtdw_i = -1/b$ . It is immediately clear from this expression that the sign of  $dt/dG$  depends on  $dx/dG$  and  $dw_i/dG$ , in addition to  $dg_i/dG$  which is an endogenous variable and is thus determined within the system. The overall effect of globalization is therefore ambiguous.

## Appendix B

**Table 4: DEFINITIONS AND SOURCES OF VARIABLES**

VARIABLE	DESCRIPTION	SOURCE
<b>Dependent variables</b>		
Primary education expenditures	Primary education expenditures as a share of total public expenditures on education	{ World Bank Edstats database
Secondary education expenditures	Secondary education expenditures as a share of total public expenditures on education	
Tertiary education expenditures	Tertiary education expenditures as a share of total public expenditures on education	
<b>Proxies for globalization</b>		
Globalization	KOF-Index of globalization	Dreher (2006a)
Openness	(Exports + Imports / GDP) in constant prices	Penn World Tables 6.3
<b>Control variables</b>		
Primary population	Share of total population aged 5 to 10 years	{ World Bank Edstats database
Secondary population	Share of total population aged 11 to 15 years	
Tertiary population	Share of total population aged 16 to 24 years	
GDP per capita	PPP-adjusted GDP per capita in constant prices	Penn World Tables 6.3
Government ideology	Index of government ideology with respect to economic policy (left-wing = 1, else = 0)	Own collection based on DPI (Beck et al., 2001)
Democracy	Index of political rights scaled from 1 = most free until 7 = least free	Freedom House

**Table 5: SUMMARY STATISTICS**

Variable		Mean	Minimum	Maximum	Std. dev.	Observations
Primary education expenditures	Overall	32.5	9.28	74.36	11.49	603
	Between		14.68	69.47	11.95	97
	Within		16.13	50.95	4.09	6.22
Secondary education expenditures	Overall	35.24	1.9	73.12	10.51	666
	Between		2	68.14	11.13	101
	Within		7.78	51.57	4.47	6.59
Tertiary education expenditures	Overall	19.3	2.67	36.82	6.86	775
	Between		5.15	34.81	6.58	112
	Within		2.49	35.34	3.3	6.92
KOF-Index	Overall	63.38	22.57	92.14	15.96	798
	Between		27.82	90.89	15.22	116
	Within		41.48	76.93	4.93	6.88
Economic openness	Overall	81.83	16.64	328.81	41.68	821
	Between		22.9	311.65	43.17	121
	Within		27.49	140.01	12.38	6.79
Primary population	Overall	13.09	6	22.38	4.68	821
	Between		6.76	21.7	4.64	121
	Within		8.19	18.42	0.89	6.79
Secondary population	Overall	7.29	3.78	11.58	2.05	821
	Between		4.12	11.15	2.01	121
	Within		5.95	8.95	0.37	6.79
Tertiary population	Overall	15.29	9.05	22.89	2.87	821
	Between		10.33	21.84	2.68	121
	Within		11.76	18.4	0.81	6.79
GDP per capita	Overall	13.95	0.59	47.25	11.14	821
	Between		0.62	42.9	10.58	121
	Within		1.54	24.49	2.15	6.79
Government ideology	Overall	0.35	0	1	0.48	821
	Between		0	1	0.4	121
	Within		-0.55	1.24	0.3	6.79
Democracy	Overall	2.84	1	7	2.12	821
	Between		1	7	2.11	121
	Within		0.34	6.34	0.51	6.79

<sup>1</sup> The number of observations is larger than in tables 1 to 3 because the regressions use lags.

<sup>2</sup> Note that the number of countries for which data is available differs between the three expenditure categories. Since for instance, data for secondary education expenditures is available for some countries for which tertiary expenditure data is not available, the total number of countries amounts to 121.

**Table 6: COUNTRIES INCLUDED IN THE SAMPLE**

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

<sup>1</sup> This table lists all countries that are included in at least one of the estimated models.

<sup>2</sup> Countries classified as "industrialized" are indicated with an "I" in parentheses (see footnote 7 for an explanation of the criteria according to which a country is classified as developing or industrialized).

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