(Mis-)Understanding Education Externalities

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ABSTRACT

This article reviews the current state of research on education externalities. It finds that much of the confusion regarding their magnitude results from conceptual misunderstandings about their nature. The concepts of 'education', 'teaching', and 'knowledge' need to be distinguished for a better understanding. Whereas pure teaching yields externalities on the primary and secondary level, only the generation of knowledge may produce the spillovers which are typically linked to the tertiary level. The accumulation of education itself does not have such an effect. Education is argued to be a private good with well defined property rights. Individuals may exploit those and provide the production sector with the efficient amount of human capital. Following this rationale, it is demonstrated that empirical studies, contrasting estimates of private and social returns to education, are unsuitable to substantiate the existence of externalities. As a consequence, subsidies to tertiary programs are called into question.

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1. Introduction

The goal of research on education externalities has been stated by Moretti (2003) to be twofold. "First it should credibly assess the magnitude of spillovers. […] A second goal should be to empirically investigate the mechanisms that give rise to externalities." (p.3). It is not last owed to the failure of research to achieve these goals that leads international governments to follow quite different strategies when it comes to the public contribution to education finance.[1] Even though economists have spent some effort in quantifying externalities (Heckman and Klenow, 1997; Krueger and Lindahl, 2001; Gundlach and Woessmann, 2004; Rauch, 1993; Rudd, 2000; Acemoglu and Angrist, 2000; Moretti, 2004; Muravyev, 2006; Ciccone and Peri, 2006), as well as private and social returns to education (see Harmon, Oosterbeek and Walker, 2003; Sianesi and van Reenen, 2003), a mutual consent has not yet been achieved. Consequently, there is no accepted guiding principle pertaining to the optimal scope of public education subsidies. This is less evident in the case of primary and secondary expenditures, but much more visible when it comes to tertiary spending. Figure 1 depicts international public expenditures on primary and secondary, respectively tertiary teaching institutions as a share of GDP. The variation in the right picture is obviously higher. The coefficient of variance is 18.2 in the case of primary and secondary spending, and 28.5 for tertiary spending. Figure 2 shows public spending as a share of total spending on educational institutions across OECD countries. The respective coefficients of variation are 6.1 for primary and secondary spending and 25.2 for tertiary spending.

[Figure 1 about here]

[Figure 2 about here]

In order to contribute to more unanimity in this matter, it appears vital to first of all suspend the ongoing quantification efforts for a moment, back-pedal and sum up what has been achieved so far. This is necessary to make sure that everyone is on the same page before continuing research. Conversations with fellow researchers have convinced me that quite a few different perceptions are out there regarding the nature and existence of education externalities. Not least, my own persistent misunderstandings encouraged me to make an attempt of bringing more light to the fogginess of the externality debate.

Consequently, this essay critically evaluates the current state of research on education externalities since their mention by Gary Becker (1964). No other contribution could be found, which narrows down previous work in a comparably concise manner and directs attention to the relevant questions, such as: Have we managed to come closer to the goal of our research? Do we actually understand the mechanisms that give rise to externalities? And if not, are we actually going where we ought to be going? Are we still on the right track with our efforts to assess the magnitude of the presumed externalities? Are our methods suitable after all? Or are we possibly in danger of spending much time and effort on obsolete analyses? In part, the article may be little more than a summary of what is written elsewhere in the literature. Nevertheless, in some crucial details it averts from long-lived thinking! In specific, it suggests that education is a private good with well defined property rights. Also, it once again emphasizes long-understood facts that have been repeated many times and are yet largely neglected. More precisely, for the case of tertiary education it is outlined that not the production of education per se, but its use in certain production processes, such as idea generation, is what yields externalities. All together, this article ought to provide an ideal starting point for future investigations in education externalities.

The essay has the following structure. Section 2 treats the basic concepts of teaching, education, human capital, and knowledge. It argues that education has the character of a private good, and it straightens up the common understanding of the educational production process. Subsequently, section 3 briefly repeats the essence of the externalities concept and reconsiders the role of potential externalities as the prime, if not the only, reason for a government to get involved with education finance. In section 4, potential externalities of education are looked at in greater detail. On the one hand, it focuses on their nature. The effect of education on economic growth is found to be the most controversial one. It is closest related to tertiary education. On the other hand, it contains a summary of the most relevant empirical contributions aimed at assessing the magnitude of growth externalities. Eventually, a discussion is provided on whether the latter may be internalized via the labor market (section 5). It is pointed out that the concept of externalities may well be overemphasized in the context of education. Instead, idea generation activities yield social benefits, which may indeed remain uncompensated. Section 6 concludes the paper and makes suggestions for further research.

2. Clarification of concepts: teaching, education, human capital, and knowledge

There has been much contemplation, and also confusion, regarding the issue of what type of good education actually is. Blaug (1970, p.16-22) argues that it may have consumption as well as investment characteristics. Also, there is no agreement as to whether education is a private, public or merit good (e.g. Rosen, 2005, p.70-71). If undergraduate microeconomic teaching is accepted to reflect the current doctrine, the least common denominator is that education is not publicly supported because of its potential public character, but because of its potential externalities (Pyndick and Rubinfeld, 2005, p.666).

From my perspective, the challenge to answer these questions arises primarily from the commingling of two different concepts. On the one hand, one could think of education as the educational programs provided by public and private educational institutions. I choose to refer to those as *teaching* or *teaching services.* On the other hand education might refer to the knowledge and skills inherent in a person after completing such a program of teaching. This is what I will actually call *education* henceforth. In my understanding the latter is equivalent to the term human capital as coined by Mincer (1958), Schultz (1960) and Becker (1964). Both terms will be used interchangeably throughout the remainder of this work. Of course, there are broader definitions of human capital. Usually the concept is conceived to include factors such as health and life expectancy. However, for most macroeconomic applications involving the concept of human capital, such as growth regressions or growth accounting exercises, it seems more practicable to think of it solely in terms of education. Health and life expectancy can be argued to be reflected in the size of the labor force.

Teaching is a service offered for consumption to individuals who decide to get educated. If it is publicly provided and financed, and every individual has a right to participate in the programs, it has the character of a public good, being non-excludable and non-rival. In the case of primary or secondary education, for instance, excludability does obviously not apply, because schooling is mandatory. Higher education, however, is partly excludable given the existence of certain entrance requirements, making it at best a club good. One might argue that teaching is a rival good because a higher demand for teaching services increases class size and impairs the quality of the provided service. In the case of university programs, however, this argument is invalid, because the quality of a lecture does not depend much on the degree of teacher-student interactivity. I am inclined to reject this view for primary and secondary teaching as well. Empirical research suggests that class size is not an important determinant of how much a single student is

able to take away from a course (e.g. Hoxby, 2000). Moreover, the service provider is likely to offer the service to a fixed class size. Of course, in the case of a public provider, the administration may well have an incentive to reduce the number of teachers per student to a minimum. So, on average, the number of students in a class may tend to exceed the optimal size. Nevertheless, a threshold level probably exists beyond which the loss of teaching efficiency is too high to be tolerable even for a public provider. Summarizing, depending on its level, teaching is a public, or, at best, a club good. Not per se, though! Non-excludability is not guaranteed in the case of private provision. Public provision is what gives it this characteristic.

In order to delimit teaching from education, it is practicable to treat it merely as one of multiple input factors to the process of personal human capital creation carried out by each individual student. I refer to the latter as the *individual education production process*. In this respect, teaching is just a fairly homogenous production factor in the production of education. The student's time and effort are additional inputs of this process. Time is an investment that may be evaluated in terms of foregone income, which could have been earned on the labor market instead (see Schultz, 1960). Whether the usage of teaching services reflects consumption or investment is not of importance for the present analyses. Certainly, Blaug (1970) is right in that it may have both characteristics. In any case, education is the outcome of this process. Contrary to what is widely believed (e.g. Rauch, 1993, p.380), it is a private good, for it can obviously not be shared and is perfectly rival and excludable. Every individual exclusively owns the property rights and has the ability to sell its personal human capital on the labor market. This is regardless of whether the teaching input was publicly or privately provided. Completing the production process analogy, the student may be viewed as the education producer. His/her *capability* may be comparable to the production technology or a productivity parameter; the higher individual capability, the more efficient the use of a given amount of input factors. Thus,

unlike the public good *teaching*, which is used as input, the final private good *education* (or human capital) is of rather heterogeneous quality.[2]

In empirical macro-economic applications it makes sense to use quantitative measures as proxies for human capital. For instance, Barro and Lee (1993) suggest using the percentage of the population who has attained primary, secondary or tertiary degrees as the highest level of education. They also provide estimates of educational attainment as figures on years of schooling at all levels of education. It basically combines the three percentages into one score, making it operable for quantitative analyses. Of course, international comparability is subject to national differences in the requirements for a certain type of degree. Recently, however, the OECD Programme for International Student Assessment (PISA) has made a more direct and internationally comparable measure of human capital quality available.[3] The study, however, only covers children in school, not those who do not consume teaching services. Additionally, it is limited to the assessment of compulsory education; voluntary efforts to produce education have not been evaluated. Hence, in order to estimate an economy's stock of human capital, it seems most practicable to combine the data with quantitative measures. Alternatively, the index of labor force quality by Hanushek and Kimko (2000) may prove useful. For historical analyses, the concept of numeracy, which makes use of the age-heaping phenomenon, has been of help (A'Hearn, Baten and Crayen, 2006).[4]

In order to further characterize the concept of education and/or human capital, it should be delimited from the concept of *knowledge*. I start by assigning the term *worldwide stock of knowledge* to the whole body of information that is available to mankind in the way that it has been written down and stored. As worldwide knowledge expands, however, some knowledge or skills may become obsolete. Or, more specifically, the quantity of information relevant to operate an economy is likely to persist. Eventually, human mental capacity is limited. Hence, some information has to be dismissed over

time. It will always remain accessible, for instance in books or on electronic media, but it will loose relevance for the operation of the economy. I refer to the fixed quantity of information and abilities necessary to operate an economy at a certain state of technology as the *relevant stock of knowledge*. Hence, the relevant knowledge is directly related to the current state of technology. It is available to everyone in the world without the possibility of exclusion and there are no rivalries involved in its usage. Consequently, teaching curricula are assumed to always be state-of-the-art in the way that they reflect this relevant body of information. Secondary schools are expected to convey a constant share of the relevant knowledge, which does not need to be quantified more concretely. University teaching allegedly covers the full body of relevant knowledge in a specific field, e.g. mechanical engineering. Current research and new insights presumably enter the teaching schedules without a time lag. I call the whole stock of knowledge offered through a specific teaching program the *program knowledge*. With the exception of primary programs it always contains a fixed fraction of the relevant stock of knowledge. Next, in my understanding, education denotes the output of personal knowledge and abilities a student was capable of creating *relative* to the potential amount that would be thinkable if the individual had perfect capability; given the inputs teaching and time. With perfect capability the student would not forget anything and be able to draw perfectly logical conclusions from the acquired mass of information, similar to a computer. Such a student would own the whole stock of knowledge offered through a specific teaching program. When earning a degree, he or she would deserve the best possible grade in every subject. Knowing that there are a bunch of other influencing factors determining grades, this simplification ought to illustrate the concept of a fictitious maximum of education producible given a certain type of teaching input. Given that the program knowledge is a fixed fraction of the relevant knowledge, it follows that the concept of education or human capital, as evaluated by the measures discussed in the previous paragraph, is

intertemporally consistent. If the transmitted knowledge as a fraction of the relevant knowledge varied from period to period, today's high school degree would constitute a different amount of human capital than tomorrow's high school degree. Romer (1990) puts it this way:

> "According to this specification, a college-educated engineer working today and one working 100 years ago have the same human capital, which is measured in terms of years of foregone participation in the labor market. The engineer working today is more productive because he or she can take advantage of all the additional knowledge accumulated as design problems were solved during the last 100 years" (p.S83-84).

Hence, the assumptions made in this paragraph are crucial to have an operable concept of human capital at hand.

3. Externalities as a reason for fiscal intervention

3.1 The concept of externalities

The first mention of the externality concept is usually attributed to Alfred Marshall (1922) whereas the credit and blame for utilizing it to explain government intervention often goes to Arthur Cecil Pigou (1920). Modern microeconomics textbooks describe externalities as the costs or benefits of a production or consumption activity that accrue to another party and are not reflected by the market price (e.g. Pindyck and Rubinfeld, 2005, p.642). Typically they are thought to be the "consequence of the failure or inability to establish property rights" (Rosen, 2005, p.82). In this case the market solution is Pareto inefficient, because individuals who have an interest in the realization or the forbearance of the activity are prevented from offering or demanding payment for it. Respectively, the

amount produced or consumed is higher or lower than the social optimum. Ronald Coase (1960, p.7-8, 15-16) has stated that the efficient allocation may be reached independent of the prior assignment of property rights, if parties are able to negotiate about transactions at zero cost. Externalities will then automatically be internalized. This is of course under the premise that property rights do exist. If they don't, non-zero transaction costs are likely to suppress bargaining activities (Mueller, 2003, p.34-35).

If private bargaining solutions do not work, government intervention can contribute to correcting the market failure basically via three ways: taxation or respectively subsidization, regulation (e.g. the setting of limits), and the definition of property rights (e.g. in the form of certificates). In an insightful working paper, Barnett and Yandle (2005), however, recognize that there may be "far fewer instances of unaddressed external costs" (p.2) than is commonly taken for granted. From their point of view, the externality concept has frequently been misunderstood, which "leads to gross overemphasis on externalities as sources of 'market failure'" (p.6). They go as far as saying that "our understanding of the nature and importance of externality has advanced very little over the last 100 years" (p.3). As a result, they even find that "the externality problem has disappeared, but it has been replaced by the public goods problem" (p.3). In other words, any externality problem emerges only if a public good is either exploited or created by production or consumption activities. Hence, it may be regarded as a public good issue.

Irrespective of whether externalities associated with the production, respectively consumption, of a good or its public character are the reason for fiscal intervention, it is difficult for the state to assess the scope of support needed to achieve the Pareto optimal solution. It has been argued that certain voting rules in a democracy may serve to automatically generate the optimal level of public spending on a public good. This is a case related to the median voter argument harkening back to Downs (1957), according to which the preferences of the median voter decide over actual political decisions.

Politicians are thought to be the marionettes of society; for the sake of staying in power they adjust their policy proposals to the preferences of the median voter. Additionally, if votes could be traded, side-payments to voters could "buy" deviations from the socially optimal decisions. Externalities might then be bargained away in the political process and the level of government subsidies would reflect the optimal choice of the electorate. The latter could be guided by many other than just monetary motives. If this was true, further economic analysis attempting to quantify externalities would become obsolete. For a number of reasons, however, this is not identical with reality. Politicians and parties do have some power and offer only a limited range of choices to select from. Moreover, voters' behavior is probably far from rational in many cases. It seems that, often, personal characteristics of politicians or the general ideology of a party are more important for a voting decision than political agendas. And not rarely a topic completely unrelated to other agenda points, dominates the election campaigns and thereby the voting decisions. Also, the specific bundling of public service offers in a political proposal may make it impossible to achieve a Pareto optimal outcome on every single public good. And finally, spending on public services could be inefficiently high because of X-inefficiency or bureaucracy. A more extensive treatment of collective decision making and its role for public service provision can be found in Mueller (2003), Cullis and Jones (1998, p.45-70) or Rosen (2005, p.111-140). As a consequence of this policy failure, economists keep spending much effort assessing the magnitude of externalities to give governments a guideline for determining the optimal scope of fiscal activities.

3.2 Other reasons for fiscal intervention

At the outset of this article it was argued that the equivocality regarding the magnitude of externalities is responsible for the irregular patterns of spending on teaching purposes across countries. This can only be true if externalities are the only - or at least

prime - reason for a state to get involved with the financing of teaching services. But aren't there other objectives a state might pursue through its financial activities? Musgrave (1959) names three major functions of fiscal actions: distribution, allocation, and stabilization. Musgrave and Musgrave (1984, p.7-16) essentially summarize those functions as follows.

The distribution function justifies fiscal interventions that aim at altering the income distribution, usually in a progressive way, by channeling resources from the wealthier to the less wealthy individuals in the population. The question of a just or fair distribution is subject to philosophical considerations. Certainly the actual scope of redistributive government spending depends on how the electorate perceives the degree of inequality in the economy. Meltzer and Richard (1981) argue that voters demand a greater extent of redistribution activities if the income distribution is less equal. Nevertheless, it is not obvious that subsidies to teaching institutions serve this purpose well. In general, redistribution is implemented most directly by a tax-transfer-scheme. Usually, progressive income taxes or taxes on luxury goods are instruments on the revenue side of the public fiscal system ensuring that resources for the provision of any public service provision are mainly derived from the wealthy. Additionally, looking at the expenditure side, public services or transfers may be targeted at specifically needy groups. It seems, however, that transfers like social welfare or public housing are much more self-evident instruments in this respect than publicly provided teaching services. Primary and tertiary programs are not restricted to the poor and, tertiary teaching has in fact been argued to entail regressive re-distributive effects (Hansen and Weisbrod, 1969; Blaug, 1982). In other words, if redistribution is the goal of fiscal activity, there are certainly more efficient ways to achieve it than financing teaching services. Hence, the redistribution function does not play an important role in the justification of public education subsidies. If anything, it might just be the second consideration. Further on, if the existence of externalities

requires public subsidies, the entailed re-distributional effects may have to be tolerated; in fact they may just be interpreted as desirable in this case.

The stability motivation describes the intention to mitigate substantial fluctuations of the economy and maintain objectives like high employment and price level stability. No separate activity, however, can be named as an instrument to achieve this goal. Rather, it is the scope of the whole budget, respectively the budget deficits or surpluses, which exerts the stabilizing influence. Consequently, thinking of teaching expenditures as a financial activity that is intended to smooth out the short-term economic development does not seem plausible.

Finally, the allocation function justifies financial intervention in order to correct market failure. The latter may be due to the public character of a good or due to externalities arising from its consumption or production. Because teaching programs are not per se public goods, but obtain this character only if they are indeed provided publicly, solely externalities are suitable to validate the allocation function when sorting out a reason for publicly financing those programs. Or, as Pyndick and Rubinfeld (2005) put it, "public education is provided […] because it entails positive externalities, not because it is a public good".

Hence, if there was any reason for the government to get involved with the financing of teaching institutions, it follows from the discussion that it could only be potentially existing externalities. In the political discussions centering tuition fees, other reasons have frequently been exploited as arguments against a private contribution to university education. Those are primarily the imperfection of credit markets, which prevents students to borrow money against their human capital, and the principal-agent problem between parents and children, stating that the former may make decisions that are disadvantageous to the child. Both cases, however, do not necessarily justify financial intervention. Other solutions involving regulatory policy are much more self-evident. This

is why externalities are the essential concept when it comes to judging the scope of public subsidies.

4. Education externalities

4.1 Nature

Section 2 has straightened up the concepts of teaching, education and knowledge. Obviously, the pure consumption of teaching does not guarantee the successful production of the good education. With this in mind, the question arises whether potential externalities are generated from the *consumption* of teaching services or from the *production* of individually bound education. The answer depends on the type of externality. I distinguish stability externalities and growth externalities.

First consider *stability externalities*. Educated people are supposed to benefit others by having a lower probability of performing criminal activities and by making more informed political decisions. Both effects presumably contribute to the stability of a society. They are commonly linked to primary and secondary education. The individual education producers, however, are not compensated for those external benefits, which is why the produced amount of primary and secondary education is generally thought to be lower than the social optimum. The Pigouvian way to solve this problem is to subsidize the production of education. One might go as far as saying that the grants should be bound to the success of the production process. In practice, however, it is the consumption of teaching services, which is publicly supported. And indeed, in the case of primary and secondary programs, even the pure consumption of teaching services may cause the mentioned externalities. Consider a situation without any fiscal contribution. If families had to pay for teaching services, there would be no way it could be made mandatory. Private institutions would emerge, probably offering very diverse and rather expensive teaching services. The wealthier would send their children to private schools; the poorer

would go to the cheaper public schools. Some, however, would not attend school at all. Additionally, there are other reasons why parents might not necessarily act in the interest of their children and send them to school if it was not mandatory. Of course, this can not be in the interest of a society, because it jeopardizes its stability. Public financing gives society the possibility to control the curricula and ensure that children receive a social imprint compatible with the internal institutions (i.e. the values) of the society (Rosen, 2005, p.71). These benefits, however, do not depend on the success of the education process. The pure presence of children in schools allows exerting some control over their development. It must be for this reason, why most societies have decided to provide primary and secondary teaching on a public basis. The literature frequently mentions other social benefits, such as the reduced likelihood of an educated person to receive public transfers or the positive environmental effects (Moretti, 2003). Other examples include longevity, health and fertility. In some cases it is disputable whether those effects can be internalized or not. Nevertheless, all together it seems to be widely recognized that public financing of primary and secondary teaching is justified.

The most frequently cited effect of human capital, however, is its important role in the process of economic development. More specifically, educated individuals drive the growth of an economy. Endogenous growth theory has been investigating this aspect since the late 1980s. Deferring the question whether these *growth externalities* are really just side-effects that remain uncompensated, the next paragraphs treat two accepted ways in which human capital influences the growth process.

According to Lucas (1988) it takes on the role of an additional production factor besides capital and uneducated labor. It augments the productivity of workers. In this model, enduring economic growth can only be achieved via the growth of the input factors. For instance a higher amount of human capital takes an economy to a higher level of income per capita. Some authors have referred to this as the *level effect* of education. In

a way, the model simply splits up the exogenous productivity parameter of the well-known model by Solow (1965) in an exogenous and an endogenous part. The growth of the latter is explained by the growth in the human capital stock. Of course, unlimited growth potential of the human capital stock is the premise for sustainable growth rates being feasible. This is realized by assuming that the accumulation of human capital in the education sector is subject to constant marginal returns. The change in the stock of human capital in each period is proportional to the level of human capital already attained. It further depends on the fraction of time a worker spends in the *education sector* as opposed to the *production sector*. What follows is a repetition of the cited level effect taking the economy to ever new levels of output in each period. The growth path is determined by the fraction of human capital diverged from the production sector in every period.

Possibly, the characterization of human capital as being able to grow without bound has its origin in the adaptation of an early endogenous growth model by Uzawa (1965). Additional to education, Uzawa explicitly considers technological knowledge, health, etc. as factors that improve labor efficiency; i.e. in other words, everything that is included in the exogenous productivity parameter in the Solow model. Of course it is plausible to assume that the sum of these factors can grow boundlessly. Borrowing this assumption and applying it to his concept of human capital, however, Lucas (1988) disregards the difference between an economy's aggregated stock of human capital and its knowledge (also see Romer, 1990, p.S79). Given the grasp of human capital as applied in this article, human capital cannot grow without bound, because it is defined in terms of skills acquired by individuals relative to the relevant knowledge. The pure advancement of skills does not necessarily augment a worker's productivity. It may merely reflect an advancement of technology and knowledge which requires workers to be more skillful. Only if skills advance faster than technology and knowledge, human capital and thereby worker

productivity is carried to a higher level. Hence, instead of thinking about Lucas' model as explaining lasting growth effects of human capital, I prefer to look at it as attributing some of the productivity shifts, which were entirely exogenous in Solow's theory, to an increase in the human capital stock (i.e. skill growth exceeding knowledge growth). Lucas (1988) distinguishes two different types of the described level effects. He calls the effect of an individual's human capital on his own productivity the *internal effect*, but argues that it may also have a productivity enhancing *external effect* on all other production factors that might not be taken into consideration when negotiating the wages of educated workers.[5] Hence, too little human capital may be accumulated. Obviously, potential externalities related to the level effect of human capital do require that the individuals successfully produce education. The pure consumption of - or investment in - tertiary programs does clearly not go along with those type of external benefits. If anything, the free-rider problem associated with public goods may entail negative externalities from the consumption activities. For instance, unsuccessful university students harm the economy by staying away from the labor market and evading their contribution to the fiscal system.

The part of the economic growth, which is based on improvements of production technologies, remains exogenous in the Lucas (1988) model. It only states that an economy can adopt the new production technology and move to a higher level if the stock of human capital is sufficient. Admittedly, this partly makes sense, because technology (i.e. knowledge) is developed on the world market and a single economy's influence may be marginal. Nevertheless, to a certain extent, homemade technology may drive growth in an economy. Romer (1990) explains why even in this respect, human capital plays a crucial role. After the potential labor force members have decided how much time to spend in the education sector, the next decision concerns the allocation of human capital to the research sector and the production sector. The share allocated to the *research and development sector* determines the capability of an economy to create new ideas or

innovations. The fraction allocated to the production sector decides about the level of technology that may be employed in the production of goods. It is important to note that research should be understood in a way that includes research activities for the purpose of technology adoption from abroad. Of course, it is likely that the adoption of existing technologies requires a lower amount of research activities than generating an innovation from scratch. Further, just like the education sector, the research sector should not be defined in terms of institutions such as universities, but rather in terms of activities that are directed towards the development of designs for producer durables. Those may include research at universities, at public or private research institutes or the R&D efforts in private enterprises.

Now, the optimal allocation of the human capital stock to the production and the research sector is the one that maximizes the total (i.e. present and future) consumption possibilities. Note that the size of the human capital stock is now exogenously given. It determines the knowledge growth rate, which is equal to the economic growth rate, and acts as a scale factor. Hence, according to Romer (1990), education - and tertiary education is the most relevant in this context - also exerts a *growth effect* via its employment in research activities. If both usages of human capital were compensated according to their marginal productivity, one would not need to worry about externalities. In Romer's model the price of a design (patent price) does mirror the potential effect of the according innovation on growth. The same applies for the potential growth effect of adopting a technology. Hence, one might argue that externalities from applied research can be internalized and that only basic research is problematic. However, the knowledge spillovers, which are entailed in idea generation, increase the productivity of every future researcher in the world. And this fact is not reflected in the patent price, because ideas and innovations have the character of a public good. This is true for basic research as well as applied research. After property right protection has expired, ideas are non-rival and non-

excludable.[6] Even though a more or less extensive time lag may be involved, sooner or later everyone in the world will have access. Romer (1990) himself states that "there is little doubt that much of the value to society of any given innovation or discovery is not captured by the inventor […]" (1990, p.S89). Also, he argues that "an additional design raises the productivity of all future individuals who do research, but because this benefit is nonexcludable, it is not reflected at all in the market price for designs. […] these effects cause human capital to be undercompensated" (p.S96). In his model, even if the socially optimal amount of human capital is accumulated opposite to the suggestion made by Lucas (1988), the cited effects may get in the way of the socially efficient allocation of human capital to the research and development sector. Hence, growth externalities may arise from the production of innovations and ideas (i.e. the use of human capital in the research sector) rather than from the pure production of education or the consumption of teaching services. Romer (1990) expects "that too little human capital is devoted to research" (p.S96). He brings forward that public subsidies can be a way to achieve the optimal allocation. Unfortunately, Romer (1990) does not make clear what should actually be subsidized. On the one hand he writes that the "social optimum can be achieved by subsidizing the accumulation of A" (p.S97), that is knowledge. In different places, however, he favors to "subsidize the accumulation of human capital" (p.S99) or advocates "a subsidy to employment in the research sector" (p.S96). According to Barnett and Yandle (2005, p.11), failure to recognize which is the "asset for which use gives rise to external effects" is responsible for much disagreement regarding the nature and existence of externalities. In the present case, this asset is the public good *knowledge*, and not education itself or teaching services! Pigou himself mentions scientific research as the "most important" source of positive externalities:

> "Lastly and most important of all, it is true of resources and activities devoted alike to the fundamental problems of scientific research, out of which in unexpected ways discoveries of high practical utility often grow, and also to the perfecting of inventions and improvements in industrial processes. These latter are often of such a nature that they can neither be patented nor kept secret, and therefore, the whole of the extra reward which they at first bring to their inventor is very quickly transferred from him to the general public […]" (1920, p.161).

Education, however, remains unnoticed.

In summary, stability externalities are associated with the pure consumption of primary and secondary teaching services and are in general thought to justify full public financing of programs on these levels. Further on, growth externalities according to Lucas (1988) - level effects - concern all levels of education. But because primary and secondary subsidies are by and large non-controversial, they are most relevant in the context of tertiary education. Successfully produced education is what generates them. Hence, strictly speaking, the allocation function of fiscal activity merely serves to justify subsidies to successful students rather than to anyone who is enrolled at a university. And finally, growth externalities introduced by Romer (1990) - growth effects - are closest linked to tertiary programs. Nevertheless, they actually arise from knowledge generation processes and are neither directly associated with teaching nor with education. In this respect, it is questionable why university teaching receives considerable subsidies in many countries.

4.2 Magnitude

In order to assess the scope of public subsidies, education externalities need to be quantified. As exemplified, the public financing of primary and secondary programs is

widely accepted because of stability externalities. In consequence, the empirical attempts of quantification are limited to the influence of education on economic growth. There is an extensive body of literature that empirically investigates the role of human capital in the process of economic development via different methods, such as growth accounting (e.g. Young, 1995; Hall and Jones, 1996) or growth regressions (e.g. Mankiw, Romer and Weil, 1992; Benhabib and Spiegel, 1994; Barro, 2001; Pritchett, 2001); Sianesi and van Reenen (2003) provide an overview over the literature on the macroeconomic effect of education. The vital question, however, is whether the education owners actually receive remuneration for this side-effect of deploying their human capital. This aspect has been the subject of research efforts much less frequently. Two types of studies will be discussed subsequently. Both focus solely on the Lucasian level effect of human capital. The principal idea underlying both approaches is to contrast the *private return* to education (i.e. the effect of individual education levels on individual income) with the *social return* (i.e. the effect of average human capital levels on everyone's income).

The first approach basically aims at reconciling micro-estimates of the private return to education and macro-estimates of the social return to education. Some endeavors include the work by Heckman and Klenow (1997), Krueger and Lindahl (2001) as well as Gundlach and Woessmann (2004). The private return is in line with what Lucas (1988) calls the internal effect of human capital. Most studies derive it from applying the standard earnings equation suggested by Mincer (1974) to micro data. It can be interpreted as the increase in personal income associated with one additional year of schooling, when experience is controlled for in the equation. For instance, Pscharopoulos (1973; 1994) has contributed much to the evaluation of private returns to education. Harmon, Oosterbeek, and Walker (2000) provide a summary of the literature on the microeconomic returns to education. As an example, one year of schooling in the United States increases individual income on average by 10% (see Psacharopulous and Patrinos,

2002, Table A.2). The social return, as estimated by the mentioned studies, includes both the internal and the external effect of human capital modeled by Lucas (1988). In order to obtain a coefficient that is comparable to the private return, usually the authors make use of what Heckman and Klenow (1997) call the macro-Mincer equation. Essentially, this is a Mincer equation applied to countries instead of individuals. Nevertheless, due to technical issues there is considerable dissension on the size of the estimated social return. Comparing this macro estimate with the widely recognized 10%-estimate of the micro return, Heckman and Klenow (1997) reject the existence of externalities. Gundlach and Woessmann (2004) instead obtain a figure for the social return in excess of that for the private return and conclude that externalities do exist. Similarly, Krueger and Lindahl (2001) estimate a macro effect which is about four times the size of the micro effect. But it is just this huge difference which makes them suspicious of their own results. They argue the finding was most likely a result of endogeneity bias, which leads them to recommend focusing on natural experiments that cause increases in educational attainment.

A second strand of literature focuses solely on evidence from micro data. Basically, these studies estimate the effect of the average level of education in a city or a state on individual wage levels within this regional unit, controlling for individual education. Observation units are individuals, clustered by cities, states or countries. The estimation equations could also be interpreted as Mincer equations augmented with the regional average level of human capital. Important examples include Rauch (1993), Rudd (2000), Acemoglu and Angrist (2000), Moretti (2004), Muravyev (2006), as well as Ciccone and Peri (2006). Because individual education is controlled for, the effect of the average human capital level on individual wages represents the social effect of education that goes beyond the private return. Hence, the authors typically interpret it directly as the size of externalities. In other words, both the internal as well as the external effect from the Lucas

(1988) model are estimated based on a single equation. Given the differing empirical specifications the findings of the studies are not directly comparable. Rauch (1993) finds that a one percentage point increase of average education in US cities raises wages by 3-5%. Acemoglu and Angrist (2000) are skeptical in light of their weak evidence for an effect of compulsory secondary schooling laws on the US state wage levels. Also, Rudd (2000) finds no support for an effect of average education on individual wages in a panel analysis for US states. Eventually, Muravyev (2006) exploits a natural experiment provided by the economic transition process in Russia and concludes that a one percent increase in the college share in Russian Cities raises residents' wages by 1.5%. A criticism brought forward against these studies states that the increase of wages in a firm, a region, or a state may just be due to the imperfect substitutability of uneducated labor, given the production technology. If a certain state of technology requires a fixed amount of uneducated labor, an increase in the average share of educated workers will drive up the wages of uneducated workers and possibly the average wage as well. As long as educated and uneducated workers are paid according to their marginal productivity, this effect does by no means indicate an externality. Moretti (2004) attacks this problem by estimating the effect on the wage levels for three separate groups of workers: high school drop-outs, high school graduates, and college graduates. He finds that not only wages in the first two groups rise with a higher share of college graduates in the cluster, but also the salaries of the latter do react in a positive way. A one percentage point increase in the supply of college graduates elevates the wage level in the same group by 0.4%; a rather weak effect. Eventually, Ciccone and Peri (2006) tackle the problem of imperfect substitutability by what they call the constant-composition approach. This method estimates the effect of changes in the supply of human capital on the (log-)change in average wages holding the skill-composition constant. It does not reveal any evidence for positive externalities.

Summarizing, the empirical evidence on educational growth externalities is limited to Lucasian level effects. There are (to my best knowledge) no studies, which try to empirically reconcile the Romer-type growth effects with the private return to researchers. Typically, the surveys are based on comparisons of the private and the social return to education. Unambiguous results, however, have not been achieved so far.

5. Discussion

5.1 Internalization of level effects

In light of the ambiguity on potential Lucasian externalities and the lack of empirical studies on Romerian externalities, it is imperative to ask whether a priori there is actually a reason to suspect that education owners might not receive the appropriate compensation for supplying human capital on the labor market. What should prevent the internalization of external benefits that is expected to take place if property rights are well defined?

I start my case by introducing the concept of an *optimal human capital stock.* Intuitively, most researchers would probably agree that there must be something like an optimal size of the human capital stock for production purposes. Depending on a country's state of technology, employers in this country may have a rather well defined need for educated labor. Neither do they want too little, nor too much of it. In the original Lucas (1988) model this point does not get clear, because the notion of human capital is one that incorporates knowledge. Whereas technology remains exogenous, human capital - including knowledge - is a production factor that may grow without bound and thereby drive productivity. The Romer (1990) model on the other hand, distinguishes between knowledge and human capital. It clarifies that technology is equivalent to the knowledge of an economy and that its growth rate is connected with the level of human capital. Nevertheless, the size of the human capital stock is exogenous. It may not grow along

with technology. Merely, the amount of human capital allocated to the production sector is allowed to adjust endogenously in the process of technological development. Hence, notwithstanding of both models' strengths in illustrating growth and level effects of human capital, they fail to capture the fairly intuitive notion of an optimal size of the human capital stock that is directly associated with the state of technology.

This notion easily applies to a dynamic context. The amount of uneducated labor (or time respectively) invested in the education sector, determines the rate of change in the human capital stock. Note, by the way, that this view deviates from Lucas' (1988) model, where not uneducated, but educated labor is allocated between the education and the production sector. Much more realistically, however, it ought to be uneducated workers, who make the decision how to allocate their time. During the production process in the education sector they create human capital, which ultimately enters the aggregate production function. The education sector encompasses all types of individual activities that may lead to an officially accepted educational degree. Now, if much uneducated labor is diverged from the production sector in order to build human capital, there may be too little left to pursue the optimal path of output growth. Nothing, however, is said about the nature of the relationship between the state of technology and the amount of educated labor needed in the production process. A technological innovation must not necessarily require more educated labor in relation to uneducated labor. The opposite may well be the case. Or no change might be needed at all. The amount of human capital produced in each period ought to be just right to keep the human capital stock at its optimal level! Given the understanding of education laid out in section 2, the fraction of time an uneducated worker spends in the education sector until successful completion of a program is a close proxy for his or her level of education. And assuming that the distributions of individual capability and students' effort are equal in all countries, "years of schooling" is a very suitable measure of human capital in cross-country applications. Based on this measure,

Krueger and Lindahl (2001) have delivered empirical evidence for the notion of an optimal human capital stock. They detect a curvilinear relationship between average years of schooling and GDP growth rates for the OECD countries. In fact, they argue, the optimum level of education, measured in terms of overall years of schooling, has already been surpassed in the average OECD country (p.1130).

Not much creativity is needed to reconcile the notion of an optimal stock of human capital with my adoption of the Lucas model stated in section 4.1: rather than interpreting the level effect of human capital on the aggregate output as driving productivity growth as suggested by Lucas (1988), I prefer to look at it as an adjustment reaction of the human capital stock to its optimal level determined by technological progress. The latter may either be due to innovations being adopted from abroad, or based on improvements created by the economy's own research sector.[7] Typically, catch-up growth of less developed countries is explained that way. Because technology is available worldwide, all that is needed for those countries to catch up is a functioning education sector. As stated earlier, some applied research activities might also be required to adopt technologies. But apart from that, it is important that the labor force is skilled to operate this technology.

However, the productivity enhancing effect of human capital in the presence of technological advancements, and the entailed adjustment of national output levels, is likely to be compensated on the labor market. Given the notion of an optimal stock of human capital in the production process, it is hard to think of reasons that could prevent individuals from exploiting their property rights when offering human capital on the labor market. After all, employers decide how much a certain type of education is worth to them. An excess supply of tertiary education in the production sector might beat down its price. Vice versa, if only few educated workers are available, their ability to negotiate higher wages rises. A priori, the price mechanism is expected to work and provide for the optimal amount of human capital being supplied.[8] Nothing suggests that the wage

differential between educated and uneducated labor would not reflect the differences in the respective marginal productivities. According to Lucas, educated individuals stimulate each others' productivity simply by communicating with each other. This seems odd however. If they occur within a firm, the spillovers are likely to be compensated by the employer. But that should also remain true for spillovers in cities, or regions arising from this type of interaction. If educated workers really have a higher probability to learn from each other, even beyond firms and cities, employers may be very aware of this specific characteristic of the production factor human capital. At the end of the day it is implausible to assume that this feature is not recognized and compensated for.

5.2 Criticism of empirical surveys

Based on the previous discussion, some criticism is advisable regarding the method of comparing private and social returns to education to assess the magnitude of externalities.[9]

I start with the studies reconciling micro- and macro-evidence. Whereas this approach appears rather intuitive and simple at first glance, it is not at all clear why it should have the ability to testify the existence of externalities. First of all, consider a given positive social return to education. Say it was estimated from a cross-section of countries. It states, as a percentage, by how much a relatively poor country's national income would grow, if the average years of schooling in the population increased by one year. Note that this shift could either reflect the higher productivity of workers, or the possibility to employ more advanced technologies in the production process because workers are better trained to implement those. In both cases, the higher output level is the result of a more efficient aggregate production process. As previously argued, however, there is no reason to believe that this increase in worker efficiency would not be recognized and compensated by the employer. At least some suspicious fact would be

needed as a hint that human capital property rights are not fully owned by the individuals. So, a priori it is hardly conceivable that workers do not get paid for this. Now assume, the private return, estimated based on a Mincer-type equation, was zero or at least very low. This makes a statement about how current labor income differences depend on the level of individual education. Because those differences reflect the expectations of employers regarding the future productive value of educated and uneducated labor as well as the scarcity of educated labor, the low return might just be a hint on an excess supply of human capital in relation to uneducated labor. And it may well be compatible with the positive macro return estimated for a cross-section of countries, which reflects the whole past influence of human capital on the historical development of those economies. If the private return sags below the social return, this may rather be a reaction of the labor market to the negative externalities of a human capital surplus. It does not indicate positive education externalities! Similarly, if the wage differentials were highly dependent on education and the private return surpassed the social return, this would just illustrate how much employers value education rather than indicate negative externalities!

Furthermore, the empirically determined wage differentials may be biased by already existing public subsidies. The flat wage structure may just be an indication of a potential crowding out. If compensation for growth effects was provided by the market, it seems plausible that government subsidies replace the market compensation if they are provided beyond the presence of externalities. The wages of academics might be substantially higher, if students had to pay for university teaching! If, in the absence of externalities, the public contribution serves to crowd out private resources that would have potentially been invested in the production of education, it would also be hard to judge the potential level of education with no public intervention. Intuitively, it would be expected to be just as high! Hence, an empirical analysis needs to be based on a real world scenario where teaching finance is solely private. There is no such country, but a few

come close to this ideal case. In the United States for instance the public contribution to tertiary teaching is distinctly smaller than in most European countries (see Figure 2). Now, if positive externalities of education did exist, one would necessarily expect a lower demand for teaching services in the country with lower teaching subsidies. Nevertheless the demand for teaching services seems to be higher in the US. Even though they have to pay for tertiary programs, more students decide to invest in college or university teaching than anywhere in Europe. Of course, one must regard the fact that the US does not have a system of vocational training. In European countries the latter soaks up many high school graduates whose counterparts in the US enjoy college teaching. Nevertheless the high demand for tertiary teaching suggests that college education pays off for the individuals. This fact sheds doubt on the existence of educational growth externalities. Much more likely, young individuals do seem to perceive the manifold benefits from education to outweigh the cost they need to incur for the teaching program. Hence, not unlikely, public subsidies in countries with high public contributions serve to crowd out private resources and flatten the wage structure. This effect can easily be reconciled with the Krueger-Lindahl finding indicating a schooling surplus in OECD countries: If there was too much education on the market due to excessive subsidization, it would not be surprising at all to find flat wage differentials, i.e. private returns lower than the social returns. Consider an exogenous increment in the time fraction each worker spends in the education sector. Say, for instance, due to a rise in public subsidies the number of students increases in the subsequent periods. This entails an increase of the human capital stock. When the first graduates of this new student generation hit the labor market they will be confronted with lower than expected wages, because there are more graduates than required by the current state of production technology. That way public subsidies to teaching programs substitute part of the labor market wage of university graduates.

Also, the micro-based estimation of social and private returns via one single equation has a caveat. Admittedly, this approach eliminates some technical problems associated with the comparison of coefficients from micro and macro regressions. Moreover, the authors of the surveys discussed in section 4.2 demonstrate creativity in exploiting natural experiments and utilizing instruments that allow dealing with the endogeneity problem. But they neglect that educated workers might nevertheless get compensated for their effect on others' productivity. Even evaluating the effect of average human capital levels on individual wages for three separate groups of workers (Moretti, 2004) does not imply that wage differentials do not reflect the differences in marginal productivities of workers. Of course, a higher share of educated labor in a regional unit may enable employers belonging to this unit to implement a more sophisticated production technology. The latter might augment the productivity of workers across all levels of education. Nevertheless, if a technology is available and an employer is waiting to apply it, he or she would be expected to take into account the productivity enhancing effect of higher-skilled labor. Again, there is no reason to suspect that he or she would offer wages to educated workers that do not reflect their marginal productivity in the renovated production process. Hence, an increase of wages in each of the three groups may well be in line with a wage differential that serves to compensate educated workers for their productivity enhancing effects. In other word, it does not indicate externalities. The same argument applies to the remedy applied by Ciccone and Peri (2006). A positive reaction of changes in the overall skill level even after a controlling for the skill-composition may be due to the adoption of a technology that increases the productivity of all levels of education.

Concluding, apart from the technical deficiencies associated with both the estimation of the micro-effect and the macro-effect - above all endogeneity problems - the whole concept of comparing private and social returns is very misleading. It does by no

means provide evidence for the presumption that workers are not compensated sufficiently for bringing their human capital into the aggregated production process. In summary, quantification trials to date can not be viewed as successful. Furthermore, the recorded surveys highlight the Lucas-type level effects of human capital only. As previously argued, it is most questionable why those should not be internalized on the labor market.

5.3 Assessing growth effects

All together, human capital does not per se yield externalities. Its level effects can most likely be internalized and the growth effects arise from idea generation. Hence, subsidizing its pure accumulation does not make sense. The market is expected to deliver the optimal solution for the allocation between production and education sector, because it is likely that employers compensate skilled workers for their ability to meet the demands associated with complex production technologies. No reason is obvious, why the prices for human capital in those two sectors should not be optimal. Subsidies may actually be detrimental, because the overall size of the human capital stock could be pushed to an inefficiently high level and cause negative externalities. Supporting the idea generation process in turn, which uses human capital as an input, would make it at the same time more attractive for individuals to produce education. But what scope of subsidies is needed to achieve the optimal allocation of human capital to the research and development sector? And what is the optimal allocation? How do you know how much more research activity at the expense of production activities a country needs? This question is not easy to answer.

First bear in mind that national income or its growth rate may not solely determine the well-being of a nation. What if non-monetary effects are taken into account? After all, growth might be perceived as a negative externality by a significant fraction of a state's

population. If growth increases inequality - and in light of the empirical evidence only few would doubt that this is the case - the less wealthy populace might actually feel threatened by economic growth. Similarly, environmental consequences of growth may be recognized negatively. When considering such intangible effects, the assessment of externalities becomes virtually impossible. The only indicator to rely on would then be public votes. True, the case that votes do not necessarily turn out Pareto efficient remains valid. But is there really any other way to judge the preferences of people? There is a reason why people vote the way they do. In specific, the poor might vote in favor of public teaching subsidies for re-distributional purposes, because inequality is costly to them in a psychological way. If the electorate grants subsidies, it might do it for a reason. In this respect, the redistributional and the efficiency-related motivation for fiscal activity become identical. On the contrary, if in an election a society votes in favor of tuition fees, this is nothing but a hint that either presumed externalities, be it future growth potential or crime reduction, are not perceived by the bulk of the populace or are valued lower than the current level of subsidies would imply. In other words, if people primarily strive for happiness, and if material prosperity is not the prime determinant of happiness (Layard, 2005), then it is hard to see why votes should not reflect the multi-faceted needs of individuals in a society. In this case, all public finance problems would be degraded from a theoretical economic problem to a rather practical socio-political issue. And it would merely inhere a positive but no longer a normative dimension. Hence, when setting aside the argument of policy failure brought forward in section 3.1, looking at votes may provide a useful reality check to assess the preferences of the electorate.

Not only can intangible negative externalities lead to an overestimation of the optimal scope of research activities. Additionally, non-monetary rewards to workers performing research activities may cause underestimation of the return to this use of human capital. First, it is likely that motivation for research activities is primarily of an

intrinsic nature. The reward comes from the satisfying character of the activity by itself rather than from external incentives such as pecuniary compensation. Undoubtedly, research activities require more creative talent than others. Creativity in turn is presumed to be higher when individuals are intrinsically motivated. Hence, it makes sense to assume that researchers have a higher degree of intrinsic motivation than other workers. In fact, external rewards have been argued to crowd out intrinsic motivation and reduce creativity (Amabile, 1983).

Second, even external incentives may be intangible. For instance, few would doubt that recognition is a crucial factor driving researchers' motivation. In other words, even if large externalities existed that researchers were not paid for (money-wise), a reason for fiscal intervention is not necessarily posed.

Given this criticism, it is moot whether quantification attempts of growth externalities can ever be successful. Nevertheless, ignoring the possibilities that growth may not be the ultimate determinant of well-being, that collective choice may internalize any externality, and that intangible rewards may suffice to compensate researchers, there is a pragmatic way for a government to pursue the efficient allocation of human capital to the research sector. Intuitively, as long as the extension of research for the purpose of idea generation and adoption, serves to increase future growth rates, it is socially efficient to channel further subsidies into this sector to compensate researchers for these externalities. This insight sets the course for future research. Empirical surveys need to investigate what is the optimal level of research activities - given a certain size of the human capital stock – in order to maximize economic growth.

It is very important to note that a rather low level of research activities might be required to generate economic growth, if a country is a technological follower. The example of Japan illustrates how an economy may achieve a high level of national income simply by adopting technologies from abroad and converging to the technological

frontier. This strategy may not require as extensive research activities as generating innovations from scratch. Hence, for a follower country, the optimal allocation of human capital may imply a smaller share of human capital in the research sector than in the case of a technological leader. This point may actually constitute a disincentive for those countries to support the research sector. The internal growth effects of an innovation are reflected in the patent price. Innovating firms within the technologically leading country may internalize them. But the external knowledge spillovers benefit the research sectors in follower countries. Hence, after all, what can be termed externality is in fact external to the economy, because knowledge is an international public good. The general free-rider problem applies and provides a disincentive for the national governmentto invest in research. Hence, a common international subsidization strategy would be most appropriate to deal with knowledge spillovers.

6. Conclusions and research agenda

The main purpose of this article was to make a step towards more unanimity on the issue of what is commonly called *education externalities*. When everyone is on the same page - that was the initial idea - it might be easier to find a generally accepted subsidization strategy for a government to pursue. The findings of this article can be summarized as follows.

Much of the confusion arises from the commingling of different concepts, such as teaching, education, human capital, and knowledge. Straightening them out makes it easier to get to the point of what mechanism actually gives rise to the frequently cited externalities, respectively what activity generates them. In terms of primary and secondary schooling, the pure consumption of teaching services may exhibit those externalities. Hence, there is little doubt that full public financing at those levels is justified. For the reason of a stable and mature society it is usually advocated that the state

provide every individual the opportunity to get educated. Participating in primary and secondary teaching is a not merely a right, but even a duty for individuals. This strategy is applicable to any economy. As regards tertiary education, the pure investment in teaching services does clearly not yield positive externalities. Rather they are thought to stem from the contribution of educated individuals to economic growth. Two types of effects have been distinguished; level effects according to Lucas (1988) and growth effects according to Romer (1990). Nevertheless skepticism is advisable.

The Lucasian (1988) level effects are likely to be internalized on the labor market. Contrary to what is commonly assumed, education is a private good and nothing suggests that property rights are not fully owned and exploitable by individuals. Empirical attempts to assess the magnitude of potential Lucasian externalities typically make use of the estimated private and social rates of return to education. This, however, has been shown to be unsuitable to testify growth externalities pertaining to level shifts. A way to cure the deficiencies and a suggestion for future research is to focus on longitudinal surveys for specific countries. The macro effect of an additional year of schooling should be estimated via time series analysis. The micro-effect of an additional year of schooling on individual wage should be estimated cross-sectionally at various points in time. If the average of those cross-sectional estimates resembles the coefficient from the time-series macro regression, the existence of externalities is unlikely. This outcome seems quite likely, given that there is no a priori rationale to worry about individuals not being able to exert their educational property rights. Further, the recognition that in the US - where public subsidies are relatively low, the demand for teaching services is relatively high – suggests that public tertiary teaching subsidies merely serve to crowd out private investment. All together, the optimal amount of human capital needed for the operation of state-of-the-art technology in the production sector can be expected to be naturally provided.

The potential internalization of growth effects caused by tertiary education according to Romer (1990) has in turn not yet been at the center of empirical studies. They arise from the use of human capital in research activities. Ignoring intangible externalities and rewards and possibility of internalization via political bargaining, it is likely that these effects cannot be fully internalized. In practice, however, it has been ignored for a long time that those externalities stem from idea generation, and not from the production of education or even the pure consumption of teaching services. More specifically, given a certain human capital stock, there is an optimal allocation of human capital to the research sector. This recognition sets the course for future investigations. Cross-country surveys should explore the empirical link between the scope of research activities and economic growth rates. The resulting relationship determines the strategy for public subsidization policy. Countries with a rather low level of knowledge generation activities may choose to extend subsidies in order to attract the optimal amount of human capital to the research sector. The public support of tertiary teaching services, however, seems to be a very questionable instrument.[10] And in fact, some countries have recently introduced a private contribution to higher education finance. Nevertheless, it is still a long way to overcome the long tradition of full public financing in many countries. Especially the imperfection of credit markets poses a major challenge in this context.

At end of this article one may wonder, whether externalities are in fact the only important determinant of public spending on teaching services. For instance, there are still substantial differences in primary and secondary public spending per student; even across countries where every student has the chance to attend a publicly financed primary and some secondary school. And this is in spite of unanimity regarding externalities. Of course, it may partly have to be attributed to differing levels of national income and the total scope of government spending as a share of GDP. Nevertheless, other factors might contribute to those discrepancies. For instance, Italy and Germany or Switzerland and

Ireland are comparable in terms of GDP per capita. So wealth cannot be responsible for the vast differences in annual expenditure on educational institutions per student between those pairs of countries (see OECD, 2006). Hence, an additional line of research should focus on the empirical determinants of public subsidies. This question is even more thronging as money does not necessarily improve the quality of education (Hanushek, 1989). It could be suspected that political factors play a role. The nature of the political system, the characteristics of political decision making processes across countries, as well as the ideologies of political leaders may be of importance. Last, but not least, it may just be historical decisions, which force an economy on a path that leads to the establishment of a certain educational policy. These early decisions may not be easily challenged even after hundreds of years. Questioning a policy with a long tradition always provokes resistance. To examine these influences it is essential to build a history of educational spending for a diverse set of countries and combine quantitative analyses with case studies that take into account the specific institutional settings of countries. This endeavor has been started by Baqir (2002), Lindert (2004) and Stasavage (2005).

Notes

1. The term "education" is used in the introduction for what should more correctly be called "teaching". It will be argued in section 2 that the commingling of those two concepts is responsible for some lack of clarity regarding the existence of what is commonly called education externalities.
2. Carrying it to the extreme, the student's brain mass may be the raw material transformed in the process.
3. The data and more information are accessible at http://www.pisa.oecd.org.
4. The term "age-heaping" refers to the tendency of people to round their ages to even numbers or multiples of five. This phenomenon is more pronounced in less developed regions. A'Hearn, Baten and Crayen (2006) argue that it reflects the ability of people to deal with numbers. Of course, it should be noted that institutional factors may play an important role in determining the necessity to know ones age.
5. Calling the latter an external effect, however, may be misleading. It will be argued later that it is hard to imagine why productivity enhancing effects of human capital would not be recognized by the employer and taken into consideration in wage bargaining.
6. Even when property right protection exists, the gains from an idea or innovation may accrue with the buyer of the research activity, unless an inventor is self-employed. That is, because he or she may not forward the full gain to the idea generator. This, however, is irrelevant in terms of externalities. The sharing of profits from an innovation between a private employer and a private employee is subject to their relative bargaining power. Again, there is no reason to think that an employee might not be able to exert his property right. The employer must compensate researchers appropriately to give them an

incentive to engage in this type of activity. Non-monetary effects associated with it, such as recognition and self-realization, may admittedly contribute to keeping salaries lower than expected given the actual monetary value of innovations. Nevertheless, from an externality point of view, the relevant issue is that too few research activities might be initiated by employers, because firms do not take into account potential knowledge spillovers.

7. This is of course neglecting the important role of institutions.
8. Of course, due to the long duration of the production process, which takes up to 20 years considering all types of education, there may be pig-cycle-like fluctuations around the optimal level of human capital.
9. Also see Pritchett (2001) for a sceptical view on the social return to education.
10. Barnett and Yandle (2005) even doubt in general that the concept of externalities is helpful to justify fiscal policy. They attribute modern interest in externalities mainly to the facts that their nature and theory has been widely misunderstood and that externalities can provide a convenient rationale to justify fiscal intervention (p.6).

References

Amabile, T.M. (1983) *The social psychology of creativity*. New York: Springer.

Acemoglu, D. and Angrist, J. (2000) How Large Are Human Capital Externalities? Evidence from Compulsory Schooling Laws. *Macroeconomics Annual* 15: 9-58.

A'Hearn, B., Baten, J. and Crayen, D. (2006) Quantifying Quantitative Literacy: Age Heaping and the History of Human Capital. Universitat Pompeu Fabra Economics Working Paper 996.

Baqir, R. (2002) Social Spending in a Panel of Countries. IMF Working Paper WP/02/03, Washington, DC.

Barnett, A.H. and Yandle, B. (2005) The End of the Externality Revolution. Mises Institute Working Paper, http://www.mises.org/journals/scholar/barnett.pdf (downloaded: January 11, 2007), Auburn, AL.

Barro, R.J. (1991) Economic Growth in a Cross Section of Countries. *Quarterly Journal of Economics* 106: 407-443.

Barro, R.J. (2001) Human Capital and Growth. *American Economic Review* 91: 12-17.

Barro, R.J. and Lee, J.-W. (1993) International Comparisons of Educational Attainment. *Journal of Monetary Economics* 32: 363-394.

Becker, G.S. (1964) *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. Chicago: The University of Chicago Press.

Benhabib, J. and Spiegel, M.M. (1994) The Role of Human Capital in Economic Development: Evidence from Aggregate Cross-Country Data. *Journal of Monetary Economics* 34: 143-174.

Blaug, M. (1970) *An Introduction to the Economics of Education*. Baltimore: Penguin Books.

Blaug, M. (1982) The Distributional Effects of Higher Education Finance. *Economics of Education Review* 2: 209-231.

Ciccone, A. and Peri, G. (2006) Identifying Human Capital Externalities: Theory with Applications. *Review of Economic Studies* 73: 381-412.

Coase, R.H. (1960) The Problem of Social Cost. *The Journal of Law and Economics* 3: 1-44.

Cullis, J. and Jones, P. (1998) *Public Finance and Public Choice*. New York: Oxford University Press.

Downs, A. (1957) *An Economic Theory of Democracy*. New York: Harper & Row.

Gundlach, E., Woessmann, L. (2004) Bildungsressourcen, Bildungsinstitutionen und Bildungsqualität: Makrökonomische Relevanz und mikroökonomische Evidenz. In U. Backes-Gellner, P. Moog (eds.) *Ökonomie der Evaluation von Schulen und Hochschulen*, Schriften des Vereins für Socialpolitik, N.F. 302 (pp.15-52). Berlin: Duncker & Humblodt.

Hall, R.E. and Jones, C.I. (1999) Why Do Some Countries Produce So Much More Output per Worker than Others? *Quarterly Journal of Economics* 114: 83-116.

Hansen, L. and Weisbrod, B. (1969) The Distribution of Costs and Direct Benefits of Public Higher Education: The Case of California. *Journal of Human Resources* 4: 176-191.

Hanushek, E. (1989) Expenditures, Efficiency, and Equity in Education: The Federal Government's Role. *American Economic Review* 79: 46-51.

Hanushek, E.A. and Kimko, D. (2000) Schooling, Labor Force Quality, and the Growth of Nations. *American Economic Review* 90: 1181-1208.

Harmon, C., Oosterbeek, H. and Walker, I. (2003) Returns to Education: Microeconomics. *Journal of Economic Surveys* 17: 115-155.

Heckman, J.J. and Klenow, P.J. (1997) Human Capital Policy. Mimeo, University of Chicago.

Hoxby, C.M. (2000) The Effects of Class Size on Student Achievement. *Quarterly Journal of Economics* 115: 1239-1285.

Krueger, A. aad Lindahl, M. (2001) Education for Growth: Why and For Whom? *Journal of Economic Literature* 29: 1101-1136.

Layard, R. (2005) *The New Happiness*, Penguin Press.

Lindert, P.H. (2004) *Growing Public - Social Spending and Economic Growth Since the Eighteenth Century*, Volumes 1 & 2. Cambridge: Cambridge University Press.

Lucas, R.E. (1988) On the Mechanics of Economic Development. *Journal of Monetary Economics* 22: 3-42.

Mankiw, G.N., Romer, D. and Weil, D.N. (1992) A Contribution to the Empirics of Economic Growth. *Quarterly Journal of Economics* 107: 407-437.

Marshall, A. (1922) *Principles of Economics.* London: Macmillan.

Meltzer, A.H. and Richard, S.F. (1981) A Rational Theory of the Size of Government. *Journal of Political Economy* 89: 914-927.

Mincer, J. (1958) Investment in Human Capital and Personal Income Distribution. *Journal of Political Economy* 66: 281-302.

Mincer, J. (1974) *Schooling, Experience and Earnings*. New York: Columbia University Press.

Moretti, E. (2003) Human Capital Externalities in Cities. NBER Working Paper 9641, Cambridge, MA.

Moretti, E. (2004) Estimating the Social Return to Higher Education: Evidence from Longitudinal and Cross-Sectional Data. *Journal of Econometrics* 121: 157-212.

Mueller, D.C. (2003) *Public Choice III*. Cambridge: Cambridge University Press.

Muravyev, A. (2006) Human Capital Externalities: Evidence from the Transition Economy of Russia. German Institute for Economic Research Discussion Paper 629, Berlin.

Musgrave, R.A. (1959) *The theory of public finance – A Study in Public Economy*, International Student Edition. New York: McGraw-Hill.

Musgrave, R.A. and Musgrave, P.B. (1984) *Public Finance in Theory and Practice*, 4th edition. New York: McGraw-Hill.

OECD (2006) *Education at a glance: OECD indicators.* Paris: OECD.

Pigou, A.C. (1920) *Economics of Welfare*. London: Macmillan Publishing.

Pritchett, L. (2001) Where Has All the Education Gone? *World Bank Economic Review* 15: 367-391.

Psacharopoulos, G. (1973) *Returns to Education: An International Comparison*. Amsterdam: Elsevier.

Psacharopoulos, G. (1994) Returns to Investment in Education: A Global Update. *World Development* 22: 1325-1343.

Psacharopoulos, G. and Patrinos, H.A. (2002) Returns to Investment in Education: A Further Update. World Bank Policy Research Working Paper 2881, Washington, DC.

Pyndick, R.S. and Rubinfeld, D.L. (2005) *Microeconomics*, 6th edition. Upper Saddle River, NJ: Pearson Prentice Hall.

Rauch, J.E. (1993) Productivity Gains from Geographic Concentration of Human Capital: Evidence from the Cities. *Journal of Urban Economics* 34: 380-400.

Romer, P.M. (1990) Endogenous Technological Change. *Journal of Political Economy* 99: S71-S102.

Rosen, H. (2005) *Public Finance*, 7th edition. Boston: McGraw-Hill/Irwin.

Rudd, J. (2000) Empirical Evidence on Human Capital Spillovers. Federal Reserve Board Finance and Economics Discussion Paper 2000-46, Washington, DC.

Schultz, T.W. (1960) Capital Formation by Education. *Journal of Political Economy* 68: 571-583.

Sianesi, B. and van Reenen, J. (2003) The Returns to Education: Macroeconomics. *Journal of Economic Surveys* 17: 157-200.

Solow, R.M. (1956) A Contribution to the Theory of Economic Growth. *Quarterly Journal of Economics* 70: 65-94.

Stasavage, D. (2005) Democracy and Education Spending in Africa. *American Journal of Political Science* 49: 343-358.

Uzawa, H. (1965) Optimum Technical Change in an Aggregative Model of Economic Growth. *International Economic Review* 6: 18-31.

Young, A. (1995) The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience. *Quarterly Journal of Economics* 110: 641-680.

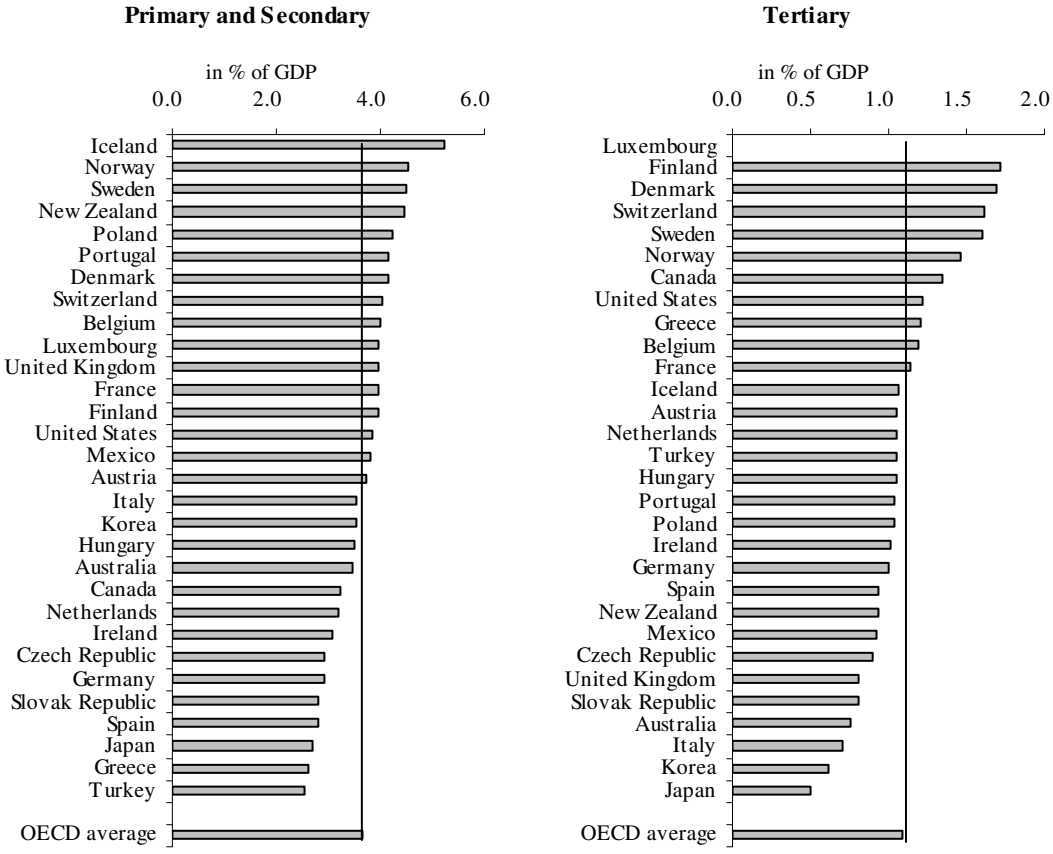

Figure 1. Public education expenditures as a share of GDP in OECD countries.

Source: OECD (2006).

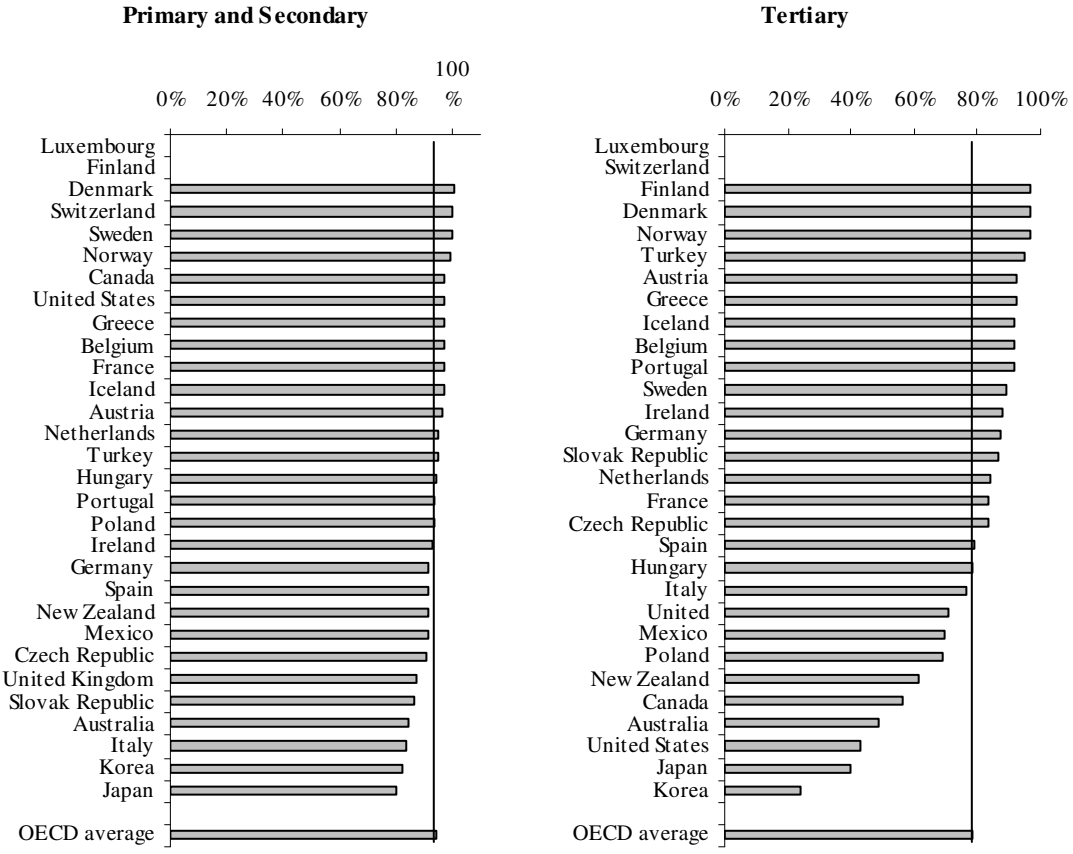

Figure 2. Public education expenditures as a share in total educational spending in OECD countries.

Source: OECD (2006).