Externalities and Optimal Subsidization of Higher Education

Stefan Winter[1] and Alexander Pfitzner[2]

June 18, 2013

Abstract

Higher education is subsidized worldwide, although with pronounced differences in levels of subsidization. While public funds account for about 90% of universities' budgets in Scandinavian countries, the share of public funds in Great Britain and the US is less that 30%. Subsidization is typically justified by two arguments: It is said to be necessary to enable children from poorer family backgrounds to join universities. The other argument holds that higher education is accompanied by positive externalities. Without subsidization, so the story reads, there would be an underinvestment in higher education. This paper shortly reviews theoretical arguments as well as empirical evidence on externalities. It is found that evidence on positive externalities is quite limited. What is more, evidence on negative externalities of higher education has been mainly ignored so far. If potential losses due to negative externalities are taken into account, there may be much more reason to suppress higher education than there is reason to subsidize it. We conclude that subsidization can be reasonable in special cases at best. We present a simple model of optimal subsidization for those cases and evaluate existing subsidization regimes in the US, Australia and Germany. We demonstrate that any of these regimes has severe shortcomings even if positive externalities are assumed to exist. While the Australian regime of income contingent loans is relatively best, it still offers many opportunities for improvement. We offer some guidance on potential improvements.

---

[1] Corresponding author. Stefan Winter holds the Chair of Human Resource Management, Ruhr University Bochum, Germane, email: stefan.winter@rub.de.
[2] Alexander Pfitzner is a PhD student at Ruhr-University

1. Introduction

According to OECD statistics[3], the 34 member states paid about 70% of the costs of higher education in 2009. The remaining 30% are covered privately. While Scandinavian countries pay for about 90%, the share of public funds in higher education in the US and Great Britain is less than 30%.[4] The average OECD country invests about 3.1% of total public spending in higher education. In 2009, the US have spent 1.3% of its gross domestic product on higher education, which corresponds to about $US 180 bn.[5] In Germany, a country strongly dominated by public universities, there are typically no tuition fees at all. Only the public universities in the federal states of Bavaria and Lower Saxony charge 1,000 € (about 1,350 $US) per year, but these fees will likely be abolished in the course of 2013.

There are two main economic arguments for subsidizing higher education. One argument holds that subsidization is necessary to avoid exclusion of poorer people from higher education. It is argued that tuition fees can only be paid by young people with financially sound backgrounds, excluding those without. The other argument deals with externalities. It is suggested that graduates produce positive externalities. Without subsidization, graduates would have to cover the entire costs of their education while part of the return on these investments would go to third parties. In this scenario, so the argument goes, there would be an underinvestment in higher education.

While the argument that tuition fees tend to exclude poorer people from higher education still holds some street credibility, the academic discourse comes to the rather definite conclusion that exclusion can be easily prevented by appropriate payment provisions. As early as 1955 Milton Friedman[6] has suggested that graduates should pay tuition fees only after their economic success becomes evident, i.e. tuition fees should be paid after graduation only and fees should depend on realized income. This idea of an income contingent loan (ICL) was firstly applied on a large scale in 1989, when Australia implemented its "Higher Education Contribution Scheme" (HECS).[7] The effects of HECS on social selectivity have been scrutinized by a couple of large scale empirical studies. It was found that there were no

---

[3] OECD (2012), 259
[4] See OECD (2012), 269.
[5] See World Bank
[6] Friedman (1955)
[7] See Australian Government

relevant effects.[8] Several countries have followed Australian's lead of an income contingent student loan scheme and adopted modified versions of HECS: For example, New Zealand as well as South Africa introduced their ICLs in 1991 and the UK followed in 1997. Tuition fees in the form of income contingent loans have been shown sufficient to prevent selection effects.[9] The role of public intervention can thus be limited to pre-finance the tuition fees. However, even this form of public intervention might not be necessary. The private German University of Witten-Herdecke offers students the opportunity to pay tuition fees in the form of income contingent loans. The University uses simple bank loans to pre-finance the costs. Our conclusion is that social selectivity of tuition fees is not a relevant topic if the scheme applied is well designed.

The remainder of this paper deals with the relevance of the externality argument in higher education finance. After a short review of the theoretical concept of externalities and their potential welfare effects in section 2, we will review the empirical evidence on externalities of (higher) education in section 3. As will be seen, there is evidence of some positive externalities of higher education. But it remains doubtful whether these externalities require subsidization. What is more, we will argue that there even may be severe negative externalities of university graduates on societies. The first conclusion from this analysis is that subsidization is neither necessary nor welfare improving in general. The opposite may be true, i.e. a general subsidization is likely to reduce welfare. This is not to say that subsidization is always wrong. Whether it is to the good or to the bad is rather likely to be case sensitive. In section 4 we thus go on to identify those situations in which subsidization improves welfare and when it will reduce it. We also discuss when and how subsidization should be implemented. We go on to evaluate existing subsidization regimes of Australia, Germany and the US. In section 5 we discuss some extensions, e.g. the relevance of incentives and insurance in human capital finance. Section 6 concludes.

---

[8] For an overview of the available literature see Chapman (2006), 1490ff. and Chapman/Tan (2008), 10ff. Chapman / Ryan (2003) also provide comprehensive information and data on university participation before and after the introduction of HECS in Australia, 15ff.

[9] See Blöndal / Field / Girouard (2002), 76-77. Also see Greenaway / Haynes (2003), 164

2. Externalities and Regulation

An externality[10] is an effect of agent A's behavior on the welfare of Agent B without an agreed compensation between them.

If an externality is negative, the private costs of A's activity are below social costs, i.e. agent A's activity harms agent B. When the externality is positive, the private benefits of A's activity are below the social benefits, i.e. agent B benefits from A's activity. While negative externalities typically lead to overinvestment in A's activities that harm agent B, positive externalities lead to an underinvestment in those activities that would benefit agent B.

2.1. Negative Externalities

As a standard example of negative externalities, consider the production of some good X. Production entails private marginal costs (PMC) borne by agent A, while additional costs, e.g. environmental damages, are borne by B. In this case, social marginal costs (SMC), i.e. the sum of costs borne by A plus the costs borne by B are higher than private marginal costs. The following figure depicts this situation.

---

[10] In this paper, the term "externality" refers to technical externalities only. We completely exclude pecuniary externalities from our analysis.
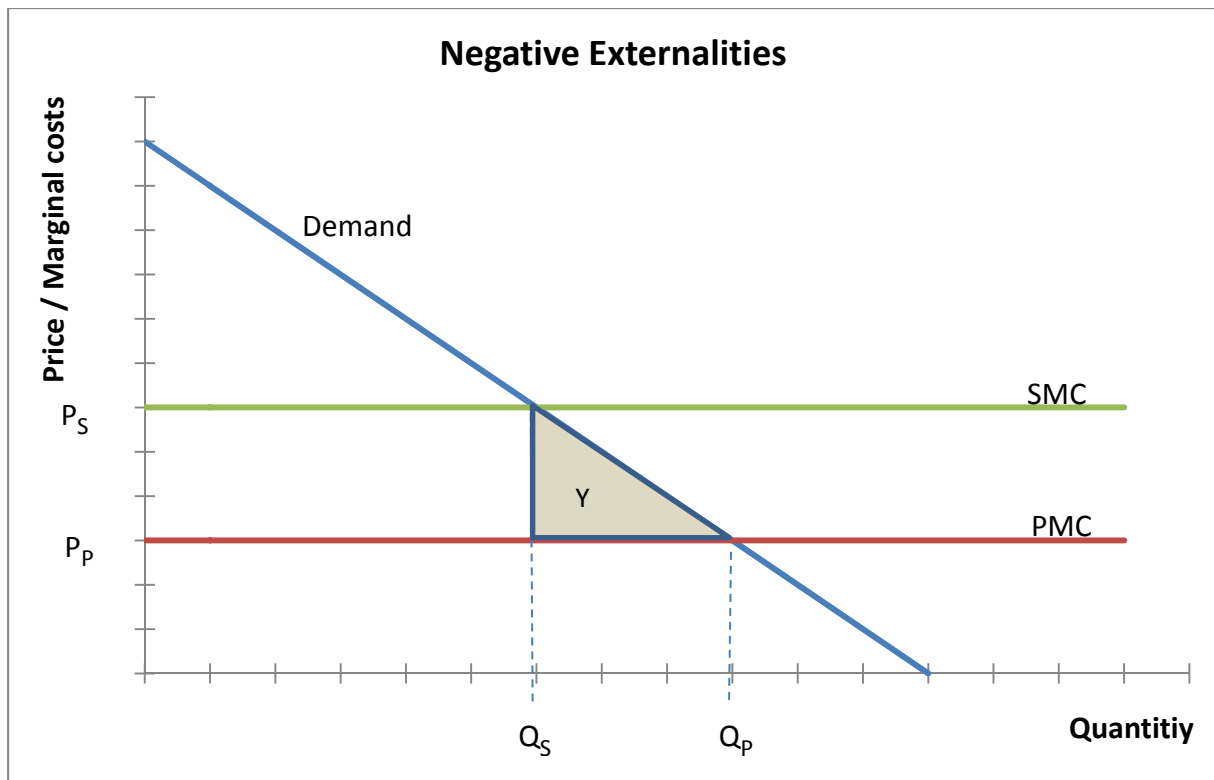
.Figure 1: Negative Externalities

If it is assumed that the market is fully competitive, the optimal quantity to be produced is defined by the point where price equals marginal costs. Since agent A bears only his private marginal costs PMC, he produces quantity Q_P. The welfare maximizing quantity would instead be Q_S, where price equals social marginal costs. Since Q_P is higher than Q_S, production and demand are higher than is socially optimal. The resulting welfare loss is given by the shaded triangle Y. The problem could be solved for example by a Pigovian tax of $P_S - P_P$ per unit. This tax would shift PMC upward to the level of SMC.

2.2. Positive Externalities

If there are positive externalities, demand will be lower than is socially optimal. This happens if private benefits of consumption are lower than social benefits. In the following figure, private demand is given by line PD, while social demand is given by SD.
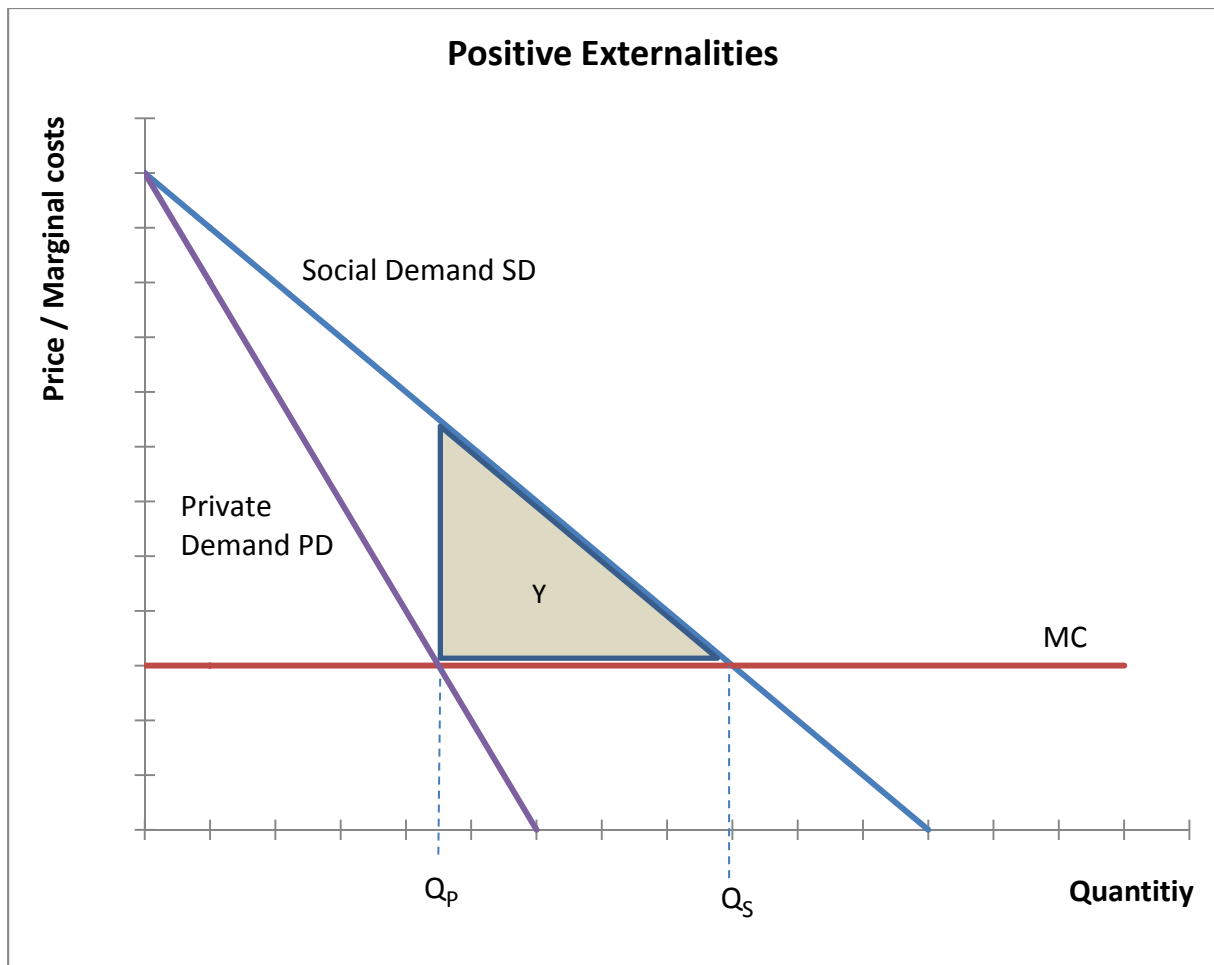
Positive Externalities

Figure 2: Positive Externalities

Private demand is optimal at the point where it equals marginal costs, which happens at quantity Q_P. Demand would be socially optimal at Q_S. Again, the welfare loss is given by triangle Y.

With respect to positive externalities of higher education, the story reads as follows: When there are positive externalities, society benefits from better educated people beyond what these people generate in returns for themselves. For example, a higher level of higher education may improve economic growth and thus makes other people better off by creating new jobs. If the costs of obtaining higher education are fully borne privately, demand for higher education will be below the welfare maximizing level. In this case, society would benefit from subsidizing the private costs of higher education or from subsidizing the returns from higher education. For example, society could cover tuition fees, at least partially or pay wage subsidies. In both cases private benefits from higher education would increase so that demand would shift upwards. In a perfect world it doesn't matter whether tuition fees or

wages are subsidized. If the correct amount of subsidization is granted, the welfare maximizing level of higher education can be achieved by both procedures.

2.3. Regulation

There are different means of intervention in the case of externalities, if intervention is necessary at all. As Coase (1960) has suggested, externalities do not require intervention at all, if private parties can contract at zero transaction costs. Only if transaction costs are prohibitively high, public intervention might be sensible. In any case, before any intervention can be reasonably justified, the ex ante distribution of property rights must be specified. This is true because absent a clear ex ante assignment of property rights, it is not possible to tell the difference between positive and negative externalities. The well known smoker / non-smoker example can be used to elaborate this argument. If society decides that smoking is a human right, i.e. the right to smoke is ex ante assigned to each human being, then non-smokers forcing smokers not to smoke harm smokers. The requirement not to smoke is thus a negative externality harming smokers. If, on the other hand, humans have the innate right to spend their lives in smoke-free rooms, then people smoking in rooms harm non-smokers. In this case, smoking is an activity with negative externalities.

If property rights are well defined ex ante, there may still be different approaches to intervention. For example, an activity that entails negative externalities may be completely forbidden, such as the private use of nuclear bombs. Or the activity may be restricted with respect to time (e.g. a ban on night flights) or place (e.g. a ban on camping in urban pedestrian zones). Under some circumstances, it's only necessary to implement a general reduction of harmful activities to improve welfare.[11] For several cases of potential environmental damages, financial interventions may be most sensible. For example, an activity may be taxed or producers are required to buy emission certificates.

The opposite techniques of intervention might be employed in the case of positive externalities. The counterpart of a prohibition is a commandment. In this case, people would be forced to provide positive externalities by fiat. An example is the legal ruling on non-assistance of a person in danger. If you do not assist someone in danger, e.g. someone injured in an accident, your neglect is treated as a criminal offense in most countries. Since you're not entitled to any form of compensation for the benefit provided, you're forced to provide

---

[11] Shavell (2004), 82.

positive externalities. Another example is that you might be responsible for clearing away snow in front of your house so that pedestrians can safely walk by. If the problem of positive externalities is tackled by financial incentives, those delivering positive externalities are rewarded for doing so.[12]

As described above, if the Coasian bargaining solution is not applicable, government interventions can be necessary to achieve welfare improvements. In general, these interventions may include Pigovian taxes, subsidies, tradable pollution permits, government provision, prohibitions, commandments, requirement rules, etc.[13]

In the practice of higher education, suspected problems of positive externalities are typically addressed with financial incentives.[14] In many countries there are tuition fee subsidies or fees are at least tax-deductible. In what follows, we restrict our analysis to financial public intervention in higher education.

3. Empirical Evidence

3.1. Positive Externalities

Productivity Growth and Spillovers: People can learn from their colleagues and thereby become more productive themselves. This will drive their wages up. In some working contexts, superior knowledge and capabilities cannot be kept private.[15] These productivity spillovers will not be considered by those obtaining higher education. Thus, the demand for higher education will be below the socially optimal level. Moretti (2004, 658) finds that the existence of spillovers cannot be rejected empirically but that the effect of spillovers on economic growth will not be large. Acemoglu / Angrist (1999) and Ciccone / Peri (2006) find no evidence for direct production spillovers of education among workers. But of course, spillovers in knowledge might not only happen in the work context but also in the private context.[16]

---

[12] For more examples of externalities and internalization see Shavell (2004), 80ff.

[13] Mankiw / Taylor (2006), 198ff. provide an overview of common options for government intervention.

[14] Much cheaper for society would be commandments. Those that could provide positive externalities would be forced to obtain higher education under such a regime. Those that do not obey would then be prosecuted for "nonassistance of a society in danger". They would be sentenced to 5 years of mandatory medicine, involuntary law, or enforced economics at Alcatraz University.

[15] Carlino (2001)

[16] Weisbrod (1964)

Economic Growth: It has been argued that better educated people drive economic growth and that third parties benefit from that growth. In order to measure whether or not there are positive externalities, empirical studies compare the private returns from higher education on the micro level with the increase in per capita income on the macro level. This stream of research suggests that there must be positive externalities if the effect of more education on private returns is below the effect of more education on income per capita.[17] Chatterji (1995) finds a significant effect of tertiary education on growth. Comparing tertiary and secondary education, Chatterji (1995) also finds that tertiary education over time has displaced secondary education as the major driver of growth. McMahon (1998) finds rather negative effects of higher education on growth for East Asian countries. As an explanation to this rather counterintuitive result, McMahon (1998, 170f.) suggests "that these nations that expanded higher education enrollments with very low tuition early also have overcrowded campuses, low quality, poor employability, and emigration among these groups, none of which is conducive to growth. Consistent with this, the regression results find higher investment in higher education as a percentage of GDP, that hopefully improves quality and is targeted so that it does not drive out private investment, is usually positively and significantly related to growth later."[18] Furthermore, Soto (2009, 10) finds that "the micro returns are not related to the social ones. Indeed, the group of countries with relatively large micro-returns has lower than average social returns in the sample."

A severe problem with this type of studies is that non-monetary returns from higher education, e.g. job satisfaction, are ignored.[19]

Higher Tax Revenues: Since graduates earn higher wages on the average as compared to non-graduates, they also pay higher taxes. These taxes are at least partially invested in public goods, generating positive externalities. Since taxes reduce private returns to higher education, taxes tend to reduce private incentives to invest in higher education. Again, the level of investments in higher education will be too low. The OECD (2011, 159) finds that in countries like Hungary, Italy and the United Kingdom the lifetime wage premium of a tertiary education exceeds $US 400,000, while the US figure exceeds $US 600,000. The higher incomes of graduates trigger higher taxes and higher social contributions, so the OECD average of the net public return on an investment in tertiary education for a man is $US 90,000 and for a woman $US 55,000.

---

[17] Heckman / Klenow (1997)
[18] See also Hanushek/Kimko (2000), Pritchet (2001), Krueger/Lindahl (2001), Cohen/Soto (2007).
[19] Barr (1993), 719.

Better Political Decisions: It is argued that higher education enables better voting decisions in democratic elections. This leads to better political decisions which in turn generate social benefits. In this context, it has been found that education significantly impacts participation rates of voters in elections. The National Center for Education Statistics (2003) has investigated the voter participation in the United States presidential election of 2000. It turned out that "52 percent of voting-age citizens who had not completed high school were registered to vote in 2000, compared with 83 percent of those with a bachelor's degree or higher. Thirty-eight percent of citizens who had not completed high school voted in 2000, compared with 77 percent of those with a bachelor's degree or higher."[20]

Weakliem (2002) has also been found that more education is associated with more liberal opinions and that better educated people are more likely to support individual choice and are thus more suspicious of authorities that restrict individual choice.[21]

Reduced Criminal Activity: It has been suggested that better education leads to a reduction in criminal activity. One reason might be that a higher level of education generates higher wages which in turn increase the opportunity costs of criminal activity. Reduced criminal activity benefits society, which constitutes another positive externality.[22] Lochner / Moretti (2003) do find a positive effect of the number of schooling years on criminal activity. They find that a one year increase in average years of schooling reduces murder and assault by almost 30%, motor vehicle theft by 20%, arson by 13%, and burglary and larceny by about 6%.[23] Furthermore, they also conclude that "a 1% increase in the high school completion rate of all men ages 20-60 would save the United States as much as $1.4 billion per year in reduced costs from crime incurred by victims and society at large."[24] However, the authors only employ data of pre-tertiary education. Their results may thus not be generalizable with respect to higher education.

Improved social cohesion: Education does not only improve productivity, it also conveys social norms and values. Shared norms and values improve social cohesion. This effect of education on social cohesion has been labeled "neighborhood effects" by Milton Friedman (1962). Again, the effect of one's own education on social cohesion will likely not be considered in educational decisions. As the OECD (2010, 92) suggests, education can

---

[20] National Center for Education Statistics (2003), 36. See also e.g. Nie/Junn/Stehlik-Barry (1996), Wolfinger/Rosenstone (1980) and Tenn (2007).
[21] Weakliem (2002), 153. See also Thaidigsmann (2004), Appiah / MacMahon (2002).
[22] Lochner (2010)
[23] See Lochner/Moretti (2003), 19
[24] Lochner/Moretti (2003), 27

significantly raise the level of civic and social engagement. It is also found that there is a substantial effect of schooling on political interest, trust and tolerance and a modest effect on voting and party membership. In addition, Dee (2004) notes that both secondary schooling and college attendance have unambiguous impacts on important elements of a functioning democracy, e.g. support for free speech.

3.2. Negative externalities

Environmental Damages: While economic growth may lead to higher employment rates, higher per capita incomes, and so on, it may also be accompanied by increasing environmental damages. So far, these damages are not fully accounted for, not at the micro and not at the macro level. But if these effects are ignored or incompletely considered, the positive effects of economic growth on welfare will be overstated.

There are a couple of studies analyzing the relation between economic growth and environmental damages. However, most of those studies deal with regional effects only and thus ignore global effects.[25][26] A good example for this local point of view is the discussion of the "environmental Kuznets curve". According to this concept, the relationship between economic development and environmental damages follows a reversed u-shape. Starting from a low level of economic activity, environmental damages increase due to more industrialization. Later on, as growth is mainly driven by service industries, environmental damages decline. However, the consumption of physical goods typically does not decline in service oriented societies. The production of these goods is thus only performed elsewhere and the environmental damages occur somewhere else. A reasonable approach must control for these relocation effects. A good example for such an approach is the study of Granados/Ionides/Carpintero (2012) on the effects of global economic growth on carbon dioxide emissions. Not surprisingly, the authors find that economic growth -measured by the growth in world's gross domestic product- is positively associated with CO_2 emissions. As Granados suggests, the world would need an economic decline of the 2007/2008 financial crisis' magnitude, to have an impact on the CO_2 concentration in the atmosphere at all. Right now, it seems futile to try to estimate the net present value of environmental damages due to economic activities and economic growth. However, it seems clear that if higher education

---

[25] McMahon (2004), 240
[26] Appiah / McMahon (2002), 41

has a positive impact on economic development, it has also a negative impact on the environment. It remains unclear so far which effect dominates.

Increased Criminal Activity: While murder, robbery, personal injury, and rape decline as the level of education increases, white-collar crimes increase. The main reason for this effect may be that white-collar crimes are more complicated to perform and thus require a higher level of education. What is more, it may be the higher incomes of graduates that make certain kinds of white-collar crimes such as tax evasion especially lucrative. Lochner (2004) estimates that one additional year of schooling would lead to an 11% increase in arrests for white-collar crimes. The damage done by the average defalcation is estimated to be around $US 1 m., while the average damage of theft or robbery is only about $US 1.000.[27] The FBI and the Association of Certified Fraud Examiners estimate white-collar crime damages of 300 – 660 $US bn. per year for the US. [28] What is more, the dark figure of white-collar crime is unknown but the true damages of these crimes are likely to be much higher than the figures reported above. [29]

Harmful Technologies: While there are many beneficial technologies, there are also highly harmful technologies that have been developed by graduates. Mustard gas has been developed by academics and has killed more than 90.000 people in World War I alone. [30] But maybe the most prominent example is nuclear weapons. Hundreds of thousands of people in Japan already have been killed or severely harmed by nuclear bombs. And today, billions of dollars are spent on the different strategies of proliferation, with highly questionable results. North Korea already has the bomb and Iran is presumably not far away. And it remains unclear whether it will be possible in the long run to keep the bomb away from terrorists.

But even without these extreme examples of mass destruction technologies, there are vivid examples of highly questionable technologies. One of these is gas extraction by hydraulic fracturing ("fracking"), a procedure that makes use of large amounts of toxic chemicals. These chemicals and exposed natural gas like methane gas are under suspicion of contaminating surface water[31] and groundwater[32]. Another example is the production of genetically modified plants, where the long run effects on human health and the environment are unknown at best.

---

[27] Payne (2011), 48
[28] Kane / Wall (2006), 5
[29] Barnett (2000), 1
[30] Duffy (2009)
[31] Olmstead, Muehlenbachs, Shih, Chu, and Krupnick (2013)
[32] Osborn, Vengosh, Warner, Jackson (2011)

3.3. Discussion

At the moment, there is some evidence of positive externalities of higher education. Especially the effects of higher education on taxes and social contributions net of human capital investments are well documented. However, those positive externalities that have been documented seem rather limited in magnitude. What is more, potential negative externalities of higher education have been mainly ignored in the debate so far. Since the negative externalities discussed above might exceed positive externalities by orders of magnitude, the case for general subsidization of higher education is more than weak.

4. Optimal subsidization

In what follows, we just assume that there might be positive externalities so that subsidization might be reasonable. We will now discuss who should be subsidized, when subsidization should be granted, and how subsidization should be implemented. It is assumed that only one unit of higher education can be obtained by each student.

The costs of higher education will be the universities' costs of producing it and the students' opportunity costs O of obtaining it. It is assumed that universities supply higher education in a fully competitive environment so that tuition fees T equal marginal costs of production. The returns will be the students' private returns from wages W plus societies' returns from positive externalities E. All variables are defined in terms of their net present values. However, wage W must be interpreted with some caution. In the context of this section we interpret W as the marginal private return to higher education. If a graduate earns total compensation C and could earn L in his best alternative non-graduate job, W is defined as $W = C - L$. By this we assume that after graduation no additional effort beyond what is needed in other jobs is necessary to realize W. Of course, this definition of W rules out some important real life incentive problems that might occur if e.g. former subsidies must be repaid on an income contingent basis. We will address these problems in later sections.

With respect to the three questions of "who", "when", and "how" we will discuss two different settings. The first setting is a perfect world. The economy is a closed one with no international mobility. What is more, information is complete and distributed symmetrically, so all relevant variables are known to every party involved. For example, opportunity costs and wages obtained later in the labor market are known to the student as well as to the government. Contracts are complete and enforceable at zero transaction costs. There is also no uncertainty, implying that timing doesn't matter. Renegotiation is impossible. Capital markets are perfect and there is thus no credit rationing. Therefore, there is no difference between subsidizing tuition fees ex ante or wages ex post.

The second setting is a world of imperfection. There might be uncertainty and the economy is open. International mobility of students and graduates is possible. Information may be distributed asymmetrically and contracts may not be enforceable at zero transaction costs. Relevant information on wages and externalities only becomes available as time passes and may be imprecise. Thus, timing matters. There might be credit rationing.

4.1. A perfect world

4.1.1. Who to subsidize

We will start by an analysis of who should not be subsidized. There is no need to subsidize students, whenever their wages W cover the sum of tuition fees T and opportunity costs O. In this case, it is irrelevant whether or not there are positive externalities at all, the corresponding student will obtain higher education anyway. This outcome is efficient. The first condition of non-subsidization thus reads:

Condition 1: $W \geq T + O$

As the empirical data suggests, there are huge wage premiums on higher education. In OECD countries, people with a tertiary education can expect to earn over 50% more than a person with an upper secondary or postsecondary non-tertiary education.[33] Given these wage premiums, there might be sufficient incentives to obtain higher education irrespective of any potential externalities.

There is another group of people that should not be subsidized. It is those people that should not become students at all. If the sum of wages and externalities $W + E$ is below the sum of tuition fees and opportunity costs $T + O$, there are no positive returns to higher education and thus there is no reason for making these people obtain it. The second condition of non-subsidization is therefore:

Condition 2: $W + E < T + O$

Conditions 1 and 2 imply that subsidization is only reasonable if both of the following subsidization conditions are met

Condition 3: $W + E \geq T + O$

Condition 4: $W < T + O$

If it is assumed that higher education is obtained whenever the wage exactly covers opportunity costs plus tuition fees less subsidy S, the efficient level of S is implicitly defined by $= T + O - S^*$. Solving for the efficient level, we get the efficiency condition:

Condition 5: $S^* = T + O - W$

---

[33] OECD (2011), 138

Solving condition 3 for E, the right hand sides of conditions 3 and 5 become identical, so one immediately obtains

Condition 6: $S^* \leq E$

i.e. the efficient level of subsidization never exceeds the value of externalities.

Condition 5 implies that for a given level of externalities and given levels of tuition fees and opportunity costs, efficient subsidization declines in wages. However, the functional relation between optimal subsidization and wages is not necessarily continuous nor must it be monotone. Let $W_{max} = T + O$. From condition 1 we know that subsidization is unnecessary whenever $W \geq W_{max}$. From condition 6 we know that an efficient subsidy can never exceed the level of externalities. It is thus possible to identify two areas in the W-S plane, where subsidization is never optimal. These areas are depicted in figure 3.
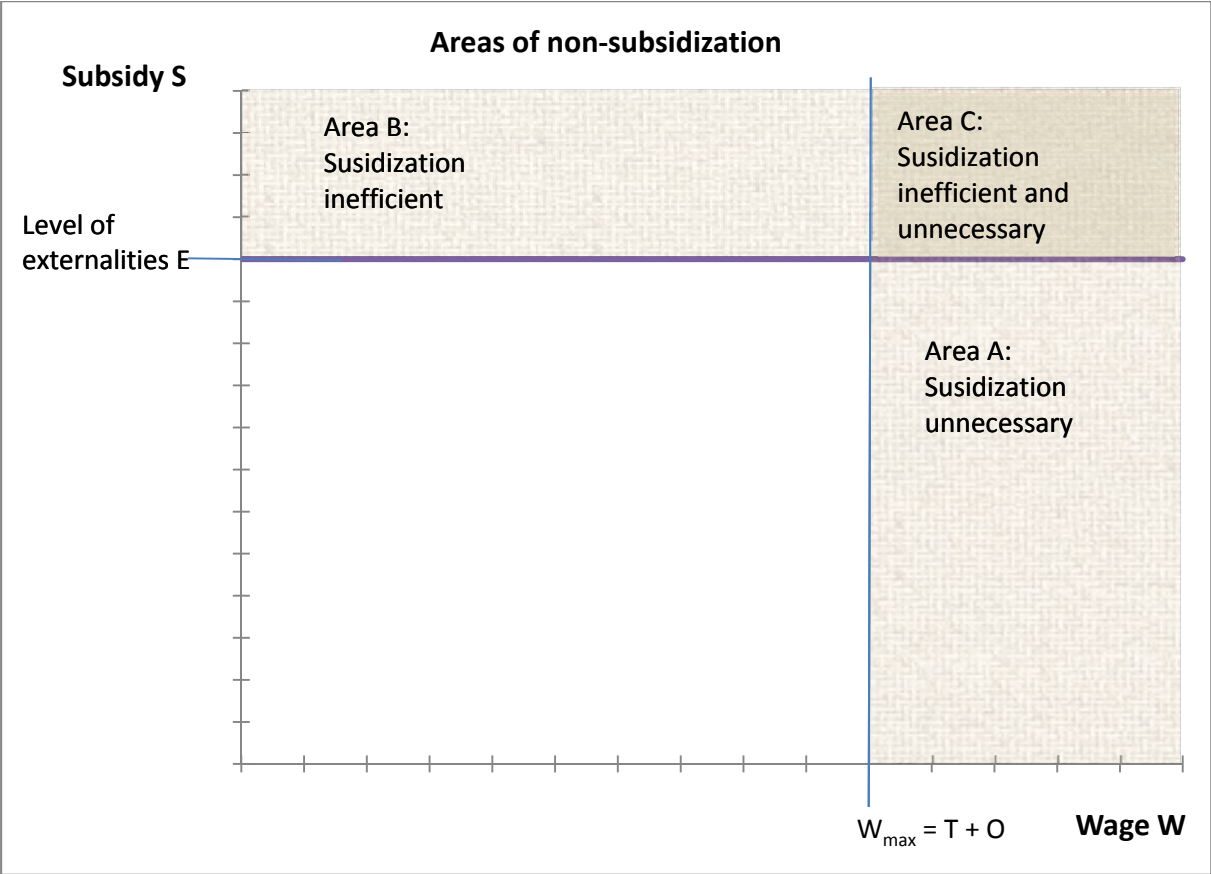

Areas of non-subsidization

- **Subsidy S**
- Area B: Susidization inefficient
- Area C: Susidization inefficient and unnecessary
- Level of externalities E
- Area A: Susidization unnecessary
- $W_{max} = T + O$
- **Wage W**

Figure 3: Areas of non-subsidization

Now assume that someone earns a wage below W_{max}. Should this person be subsidized? The answer obviously depends on the level of externalities.

Case 1: High externalities: $E \geq T + O$

Assume that the level of externalities exceeds a student's total costs of higher education, i.e. the sum of tuition fees and opportunity costs. In this case, subsidization sufficient to make the student obtain his unit of higher education always improves welfare. Let $E_{min} = T + O$. If the actual level of externalities exceeds E_{min}, i.e. $E \geq E_{min}$, every student with a wage less than W_{max} should be subsidized. The red line in figure 4 depicts the optimal level of subsidization $S^* = T + O - W$ as given by condition 5 for this case.

Optimal subsidization

Subsidy S

Area B: Susidization inefficient

Area C: Susidization inefficient and unnecessary

Level of externalities E

$E_{min} = T + O$

Area A: Susidization unnecessary
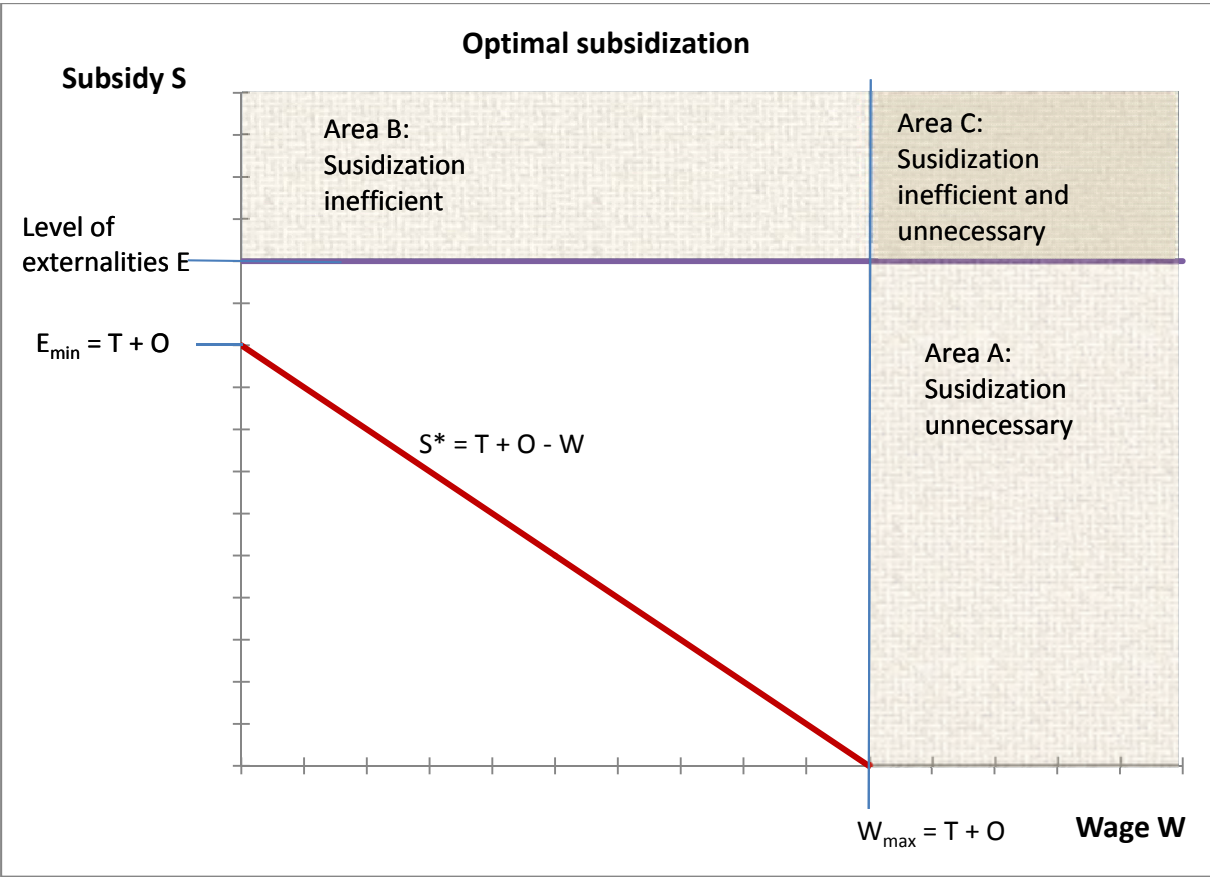
$S^* = T + O - W$

$W_{max} = T + O$

Wage W

Figure 4: Optimal Subsidization with high externalities

Case 2: Medium externalities: $0 \leq E < T + O$

If the sum of wages and externalities does not cover total costs, i.e. $W + E < T + O$, there should be no subsidization. Let $W_{min} = T + O - E$. Optimal subsidization requires $S^* = 0$ for $W \leq W_{min}$. The red line in figure 5 depicts the level of optimal subsidization in the case of medium externalities.
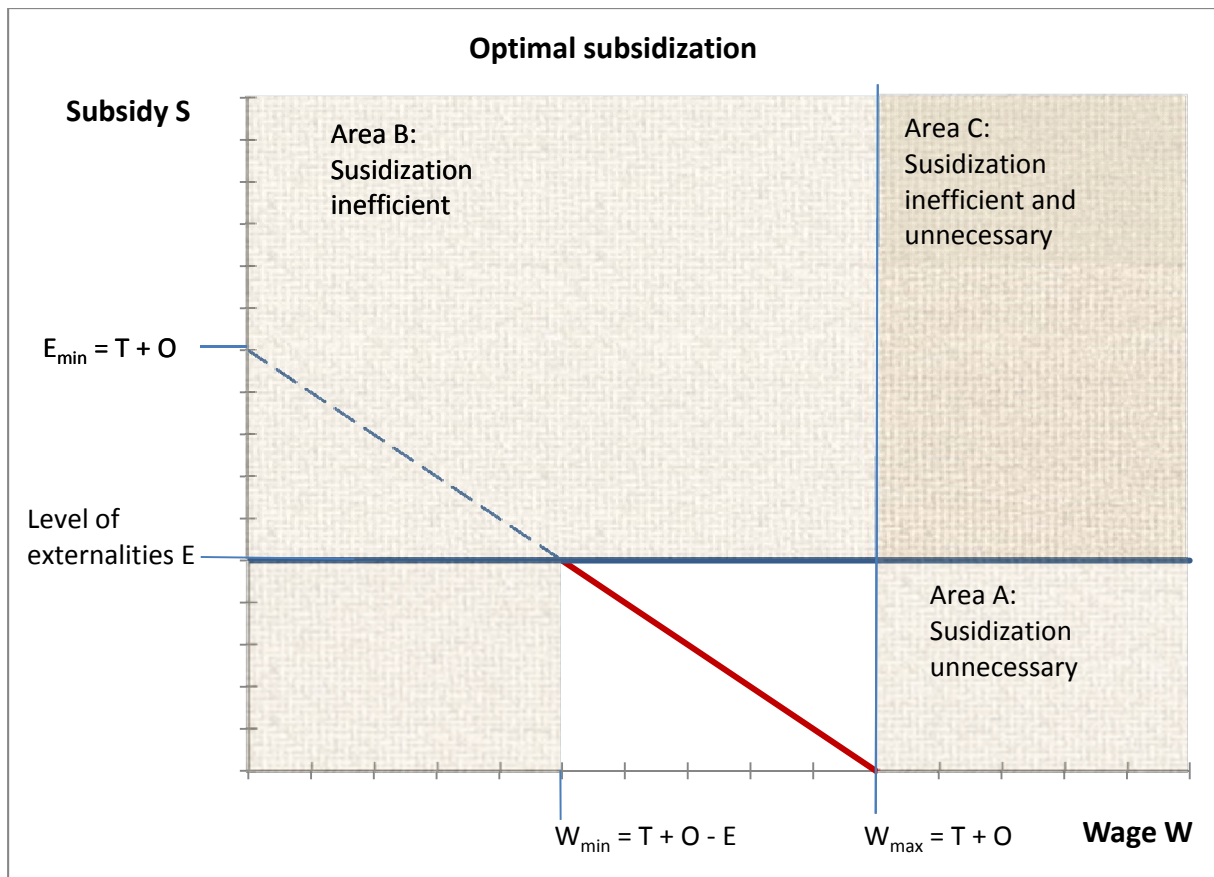
Figure 5: Optimal Subsidization with intermediate Externalities

Of course, students that later on would earn wages below W_{min} will prefer not to obtain higher education at all. Higher education is thus obtained only by those earning wages above W_{min}.

Case 3: No externalities: $E = 0$

With no externalities, any form of subsidization would reduce welfare.

W has been defined as the quasi rent of higher education, i.e. $W = C - L$. In what follows we assume that opportunity wage L is known. By assumption, total compensation is also known so W can be computed. Let total utility U be defined as

$U = W - T - O + S$

Higher education is obtained if $U \geq 0$. Let U^* be total utility under optimal subsidization S^*, i.e. $U^* = W - T - O - S^*$. Optimal subsidization S^* is given by:

$$S^* = \begin{cases} T + O - W & \text{if } W_{min} \leq W \leq W_{max} \\ 0 & \text{else} \end{cases}$$

Assume that there is a medium level of externalities. Then total utility under optimal subsidization can be depicted as in Figure 6 by the marked green line. The red line still depicts subsidization.
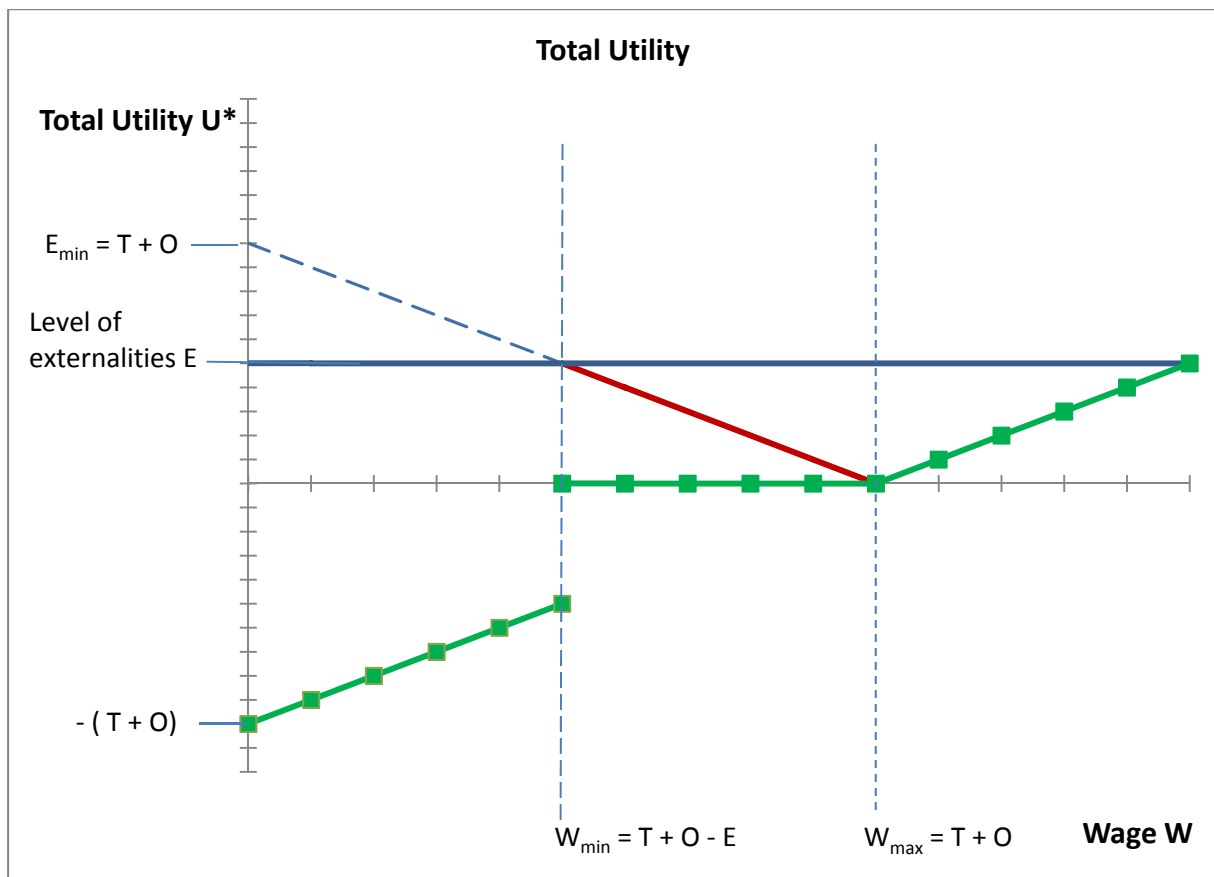

Figure 6: Total Utility under Optimal Subsidization

4.1.2. When and how to subsidize

In a world of certainty where only net present values matter, any of the different approaches of subsidization is as good as any other. Since contracts are assumed to be enforceable, the government can pay tuition fees or promise to pay a wage subsidy. Since by assumption the student can be forced to produce externalities if they exist, it doesn't matter when subsidization takes place. There is thus no difference between subsidizing tuition fees and wage subsidies. Timing also doesn't matter.

4.2. An imperfect world

In a world of asymmetric information, international mobility and non-enforceable contracts, perfectly efficient subsidization might not be possible anymore. A complete model of all effects is beyond the scope of this paper, so we restrict ourselves to suggest some rather simple, but we feel robust, rules of thumb.

4.2.1. Who, when and how to subsidize

The conditions 3 and 4 of section 4.1. still define who should be subsidized. And conditions 5 and 6 still define the efficient level of subsidization.

However, information needed to calculate the efficient level of subsidization may not be available with sufficient precision. What is more, wages as well as externalities become known only ex post, if they become available at all.

Nonetheless, it is still possible to rule out some regimes of subsidization that are clearly dominated. But as will become clear, the questions of "who", "when" and "how" cannot be separated anymore. To calculate the efficient level of subsidization, one would need information on W, E, O and T. But opportunity costs, externalities and Wages will not be observable during the time of study. However, a sound regime of subsidization should make use of as much information as can be obtained.

At the moment of study, exact information is only available on tuition fees T. While opportunity costs are not directly available, it still might be possible to estimate them with sufficient accuracy. One approach might be to employ data on incomes of the same age cohort with the same prior education. One might even control for quality of prior education and school performance. People with a first class educational background that have obtained excellent grades will be likely to perform better in the labor market than those with a third class background and intermediate grades. Thus, opportunity cost of the latter can be estimated to be lower than opportunity costs of the former. While it will likely not be possible to estimate opportunity costs perfectly on an individual level, information on the costs of higher education may nonetheless be available with sufficient precision.

However, at the moment of study, there is no information on wages or externalities available at all. But without employing ex post information about private and social returns of higher education, it is impossible to devise a regime of subsidization that cannot be dominated by another regime of subsidization that additionally makes use of wages and/or externalities.

To see this, assume that there is some regime S_1 of subsidization that only makes use of T and O, i.e. $S_1 = S(T, O)$. Now assume that there is a regime S_2 that makes use of only one additional piece of information on E, i.e. $S_2 = S(T, O, E)$. Define S_2 as follows:

$$S_2 = \begin{cases} S_1 \text{ if } E > 0 \text{ or } E \text{ is unknown} \\ 0 \ \ \text{ if } E = 0 \end{cases}$$

S_2 mimics S_1 with the only difference that under S_2 there will never be subsidization in the clear cases of E=0. If some student receives subsidization under S_2, he will also receive the same amount of subsidization under S_1. But S_2 rules out subsidization in those cases where it is clearly inefficient, which S_1 does not rule out. Therefore, S_2 weakly dominates S_1.

We thus suggest Proposition 1:

There is always a subsidization regime $S_2 = S(T, O, E, W)$ that weakly dominates any subsidization regime $S_1 = S(T, O)$. Hence, any regime $S_1 = S(T, O)$ is weakly inefficient.

From Condition 5 we know that efficient subsidization also requires the consideration of wages. However, wages W so far have been defined as quasi rents of higher education. While total compensation C might be observable with sufficient precision, opportunity wages L are not. However, it still may be possible to approximate opportunity wages by observing compensation of individuals with similar characteristics employed in non-graduate jobs. If observing compensation data of others generates an estimated value of an opportunity wage of $\hat{L}$, and total compensation is C, then the estimated quasi rent W is simply $\hat{W} = C - \hat{L}$. From Condition 1 we know that subsidization is not necessary if $W \geq T + O$.

This yields Proposition 2:

There is a wage level W_{max} so that for any subsidization regime $S_2 = S(T, O, E, W)$ the optimal level of subsidization is zero if $\hat{W} \geq W_{max}$.

For high income graduates it simply doesn't matter whether or not they produce externalities. Of course, Condition 1 refers to net present values of lifetime wages. These are not observable ex ante. However, there will be graduates that will have earned enough money after some years so that it will become clear that they meet the income condition of Proposition 2. What is more, it would even be possible to collect repayments only after death, when data on total lifetime income is available. Such a collection procedure would closely resemble an inheritance tax.

From Condition 2 we know that there should be no subsidization at all for unproductive people. But whether or not someone is unproductive becomes only known after graduation. This implies that subsidization of tuition fees is inferior to wage subsidies. To see this, assume that student A receives some tuition fee subsidy of size S. If later on it becomes evident that this student meets Condition 2, i.e. $W + E < T + O$, then S turns out to be inefficient. But if W is really low, it might not be possible to recover S from the student. On the other hand, a wage subsidy can be paid conditional of the job performed and the wage received. Assume that someone studies medicine and then decides to live as a hermit in the Redwood forest. If tuition fees have been subsidized, this money is irrevocable. On the other hand, a wage subsidy can be withhold, so there are no losses due to subsidizing hermits. Now let S_T be a regime of tuition fee subsidization and let S_W be a regime of wage subsidization.

We thus suggest Proposition 3:

For any regime of tuition fee subsidization S_T there is always a regime of wage subsidization S_W that is at least as efficient as S_T.

4.2.2. Some Applications

Application I: Tuition fee subsidization in Germany

Public universities in Germany charge no or only marginal tuition fees, i.e. tuition fees are mostly or completely covered by public funds. Therefore, there is massive, case insensitive subsidization of higher education in Germany which completely ignores information on wages and externalities. The black line in the following figure 7 depicts total utility under the German subsidization regime. The marked green line still represents total utility under optimal subsidization.
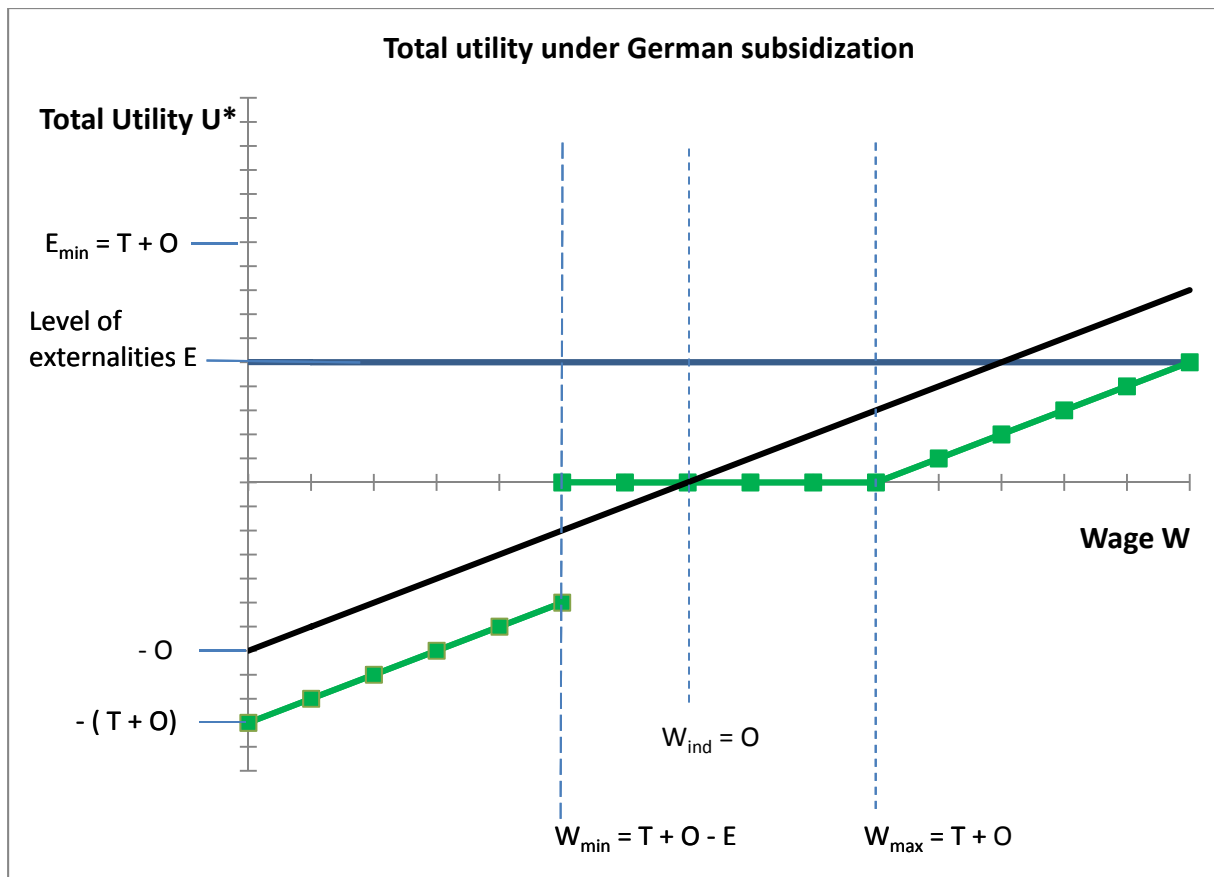
Figure 7: The German Regime of Subsidization

Inspection of Figure 7 immediately reveals that there is just the one and only student with the indifference wage W_{ind} who is subsidized correctly. Students in the wage range $W_{min} \leq W \leq W_{ind}$ are not subsidized enough, so they do not obtain higher education. All Students with wages above W_{ind} are subsidized too much. There is thus much redistribution to the benefit of highly paid graduates. At the same time, the total number of students that obtain higher education is too low in this case.

As the share of tuition fees as a percentage of total costs T + O increases, the black line of total utility shifts upward. The effect of this shift would be that more and more people would obtain higher education. In the case of zero opportunity costs, everyone would obtain higher education under the German subsidization regime. This would even be true without externalities. In this case, too many units of higher education are obtained. There is inefficient overinvestment.

Admittedly, we have so far ignored that there are income taxes. The German tax system is characterized by progressive taxation. High income individuals are therefore taxed disproportionally high. So in fact, there is some repayment of tuition fee subsidies. But

repayment via taxes has always some severe shortcomings. The most obvious being that no taxes are paid by those leaving the country. At the beginning of 2013, about 17,000 physicians that have studied in Germany are working abroad.[34] Almost all of them have studied at public universities and paid no tuition fees. The total subsidization figure of these 17,000 physicians is estimated to be about € 3 bn. This money is a complete welfare loss. What is more, at the beginning of 2013 there are more than 200.000 foreign students enrolled in German universities.[35] Most of them will leave Germany right after graduation. This also implies heavy welfare losses. Of course, this situation is not only observable in Germany. Other countries have even more severe problems with their tax financed higher education systems. In 2012, a little less than 500 graduates in Bulgaria received their licenses to practice medicine. In the same year, more than 500 physicians emigrated from Bulgaria.[36] Similar situations can be found in Poland, where more than 20% of the physicians is 70 years and older.

Another shortcoming of tax financed systems is that those with the same incomes pay the same taxes irrespective of the subsidies they have received. For example, subsidization of medicine is estimated to be around €180,000 per student, while economics is subsidized with something around €20,000.

Subject	Average costs per year in €
Medicine	29,700
Mathmatics / Natural Sciences	8,000
Engineering	6,700
Linguistics / Cultural Studies	5,300
Law / Economics	4,200

Table 1: Costs of higher education in Germany by subject[37]

If the physician and the economist later on earn the same wages, both pay the same taxes. This is an implicit redistribution of incomes. If taxes would be reduced and tuition fee subsidies would have to be repaid directly, the net income after taxes and repayment of subsidies of the economist would rise while the net income of the physician would decline. Since economics as well as medicine generate high incomes on the average, implying that there is no need to subsidize at all, there is no reason to change their relative attractiveness by

---

[34] Gerlach (2012)
[35] Isserstedt (2011), 10-11.
[36] Boy (2013), 3.
[37] Statistisches Bundesamt (2011), 51.

subsidizing medicine more than economics. This only distorts young peoples' preferences for different jobs.

Although we mainly restrict our analysis to financial techniques of tackling problems due to externalities, there are also non-financial benefits for graduates provided by society. One of the most prominent is labor market regulations. If physicians or lawyers can only start to practice after successful graduation, those that have not invested are excluded from providing these professional services. This exclusion protects the returns of those that have invested in obtaining their degrees. This situation can be compared to the grant of patent protection in the pharmaceuticals industry. Absent patents, developing new drugs would induce high positive externalities for producers of generics. Private returns and social returns of developing new drugs would fall apart dramatically. In this situation it would not be profitable anymore to develop new drugs. Public intervention could thus prescribe that the costs for developing new drugs are subsidized. But obviously this does not happen. Instead, governments protect patents and prosecute those that violate them. Protecting returns is thus a substitute for subsidizing costs. What is striking now is that in Germany, as well as many other countries, labor market regulation grants patent-like protection to those who have invested. Given the high incomes of physicians, this kind of protection seems to work more than well. But the costs of investments (tuition fees) are unnecessarily subsidized on top.

Last but not least, the German regime of subsidization is one of central planning. Subsidies are given to universities and not to students. Such a regime of central planning is superior to decentralized student decisions only if it is assumed that students make inferior choices compared to a central planning agency. There is little reason to believe that this is the case. Instead of subsidizing universities and prescribing the number of students to be enrolled in the different subjects, students could be given vouchers instead. A system of tax-financed vouchers would presumably help to limit some of the worst excesses of misallocation. For example, there are programs where students have to wait for years to get enrolled and then spend their student life in overcrowded lectures with hundreds or even more than 1,000 participants while other programs hardly attract a handful a students. What is more, there is even kind of a prisoners dilemma situation with respect to financing universities. Universities in Germany are financed at the state level, not on the federal level. State governments thus have incentives to cut investments in higher education. To solve this problem, state governments bargain over the number of university places to offer. The bargaining result is

typically that the number of enrollments increases but the average subsidy per student declines. The system thus creates severe free rider problems.

Application II: Tuition fee subsidization in Australia

Australia has implemented its Higher Education Contribution System (HECS) for public Universities in 1989. HECS prescribes that graduates with an income exceeding some threshold level must partially reimburse tuition fees.

In a perfect world it doesn't matter whether wages or tuition fees are subsidized. As suggested by Proposition 3, wage subsidization weakly dominates tuition fee subsidization in an imperfect world. However, if there is credit rationing, this conjecture may not be valid anymore. If a student cannot borrow against his future income, he may not be able to cover unsubsidized tuition fees. In this case, wage subsidization may not work well. Still, subsidization of tuition fees can be turned into wage subsidization ex post at least in cases of high incomes. If tuition fee subsidies have to be repaid on an income contingent basis, they are actually turned into wage subsidies. The Australian HECS does just that. Repayments depend on income with an income threshold.

However, under HECS there is an upper bound on what has to be repaid. This upper bound is below the true value of subsidies. Hence, tuition fees under HECS are generally subsidized for all students, even those with the highest incomes.

It is not straightforward to analyze the effects of HECS on total utility in the context of our model. This is true since the terms of HECS refer to yearly incomes while our analysis so far has referred to net present values of lifetime incomes. We must therefore make some assumptions to reconcile the model with reality. Our first assumption is that yearly wages are constant. What is more, we ignore inflation and discounting, so the net present value of lifetime income is just a multiple of yearly income. These assumptions imply that if someone's income exceeds the HECS threshold, the maximum repayment amount is due. Let W_{thr} be the threshold wage. The discontinuous black line in Figure 8 depicts total utility under HECS. The marked green line still represents total utility under optimal subsidization.
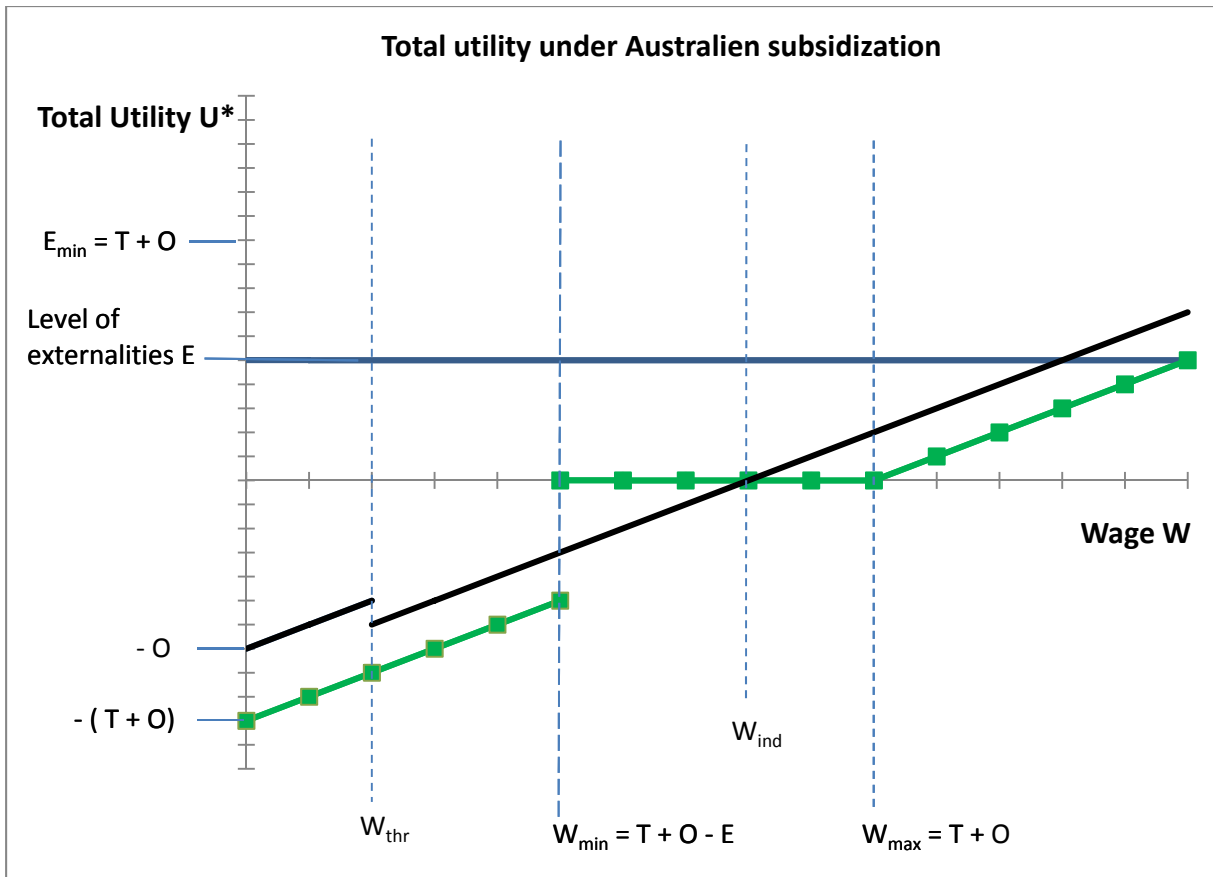
Figure 8: The Australian Regime of Subsidization

In the interval $0 \leq W < W_{thr}$ no tuition fees have to be repaid. For wages exceeding W_{thr} there is partial repayment of subsidies. For wages between W_{min} and W_{ind} subsidization is not sufficient, there is underinvestment in higher education. For wages above W_{ind} there is unnecessary high subsidization to the benefit of high income graduates.

If the Australian HECS regime is compared to the German regime, there are obviously only two differences: The level of subsidization is lower under HECS and there is a discontinuity. However, the similarities are striking.

Application III: Tuition fee subsidization in the US

Tuition fees at public Universities in the US do not cover universities' costs. Public universities receive public funds to cover the difference between costs and tuition fees. In effect, this is a regime of tuition fee subsidization. For example, the University of California reports that in year 2011-2012 total expenditures per student averaged \$US 17,390, with \$US

6,770 coming from state funds.[38] The State University of New York reports for 2012 that it received $US 461 million in state and federal grants directed at tuition assistance.[39] SUNY reported to have spent 2.1 bn. on instruction, while it received 1.2 bn. in tuition and fees.[40] While the level of subsidization is lower than the German level, the overall characteristics are the same. Hence, there is no need for an additional analysis.

Comparisons

If the different regimes are compared, there are a couple of striking similarities. The first being that none of the regimes fully withdraws subsidies from the highest income individuals ex post. This is rather puzzling, since neither incentives to obtain higher education nor incentives to work would be severely harmed if subsidies would have to be fully returned. To given an example: medicine is the most expensive discipline. Under all three regimes, medicine is subsidized more than any other discipline. At the same time, physicians in all three countries are among the academic top performers with respect to income. Table 2 below presents data on physicians' incomes in Germany. Physicians in Germany earn the highest average incomes of all graduates. The 2006 total average yearly income is about 72,000 Euros. This is almost exactly twice the income of non-graduate full time workers' average incomes.

Age	Yearly average gross income in €
25-29	49,068
30-34	56,568
35-39	67,080
40-44	78,732
45-49	87,828
50-54	91,452
55-59	91,044
60-64	93,816
>65	-
Total Average	72,372

Table 2: 2006 Age/Income profile of German physicians[41]

It is simply not reasonable to assume that someone would abstain from becoming a physician if he would have to fully return tuition fee subsidies when his average yearly income exceeds say €100,000.

---

[38] University of California, 3
[39] State University of New York (2013), 10
[40] State University of New York (2013), 8, 10
[41] Statistisches Bundesamt (2008), 27

The next similarity is that subsidies do not have to be reimbursed after emigration. If graduates leave their respective countries, there is no reason to believe that they still produce positive externalities for the societies that paid their education. It is thus hard to see why countries let people emigrate without requesting repayment. In fact, the German University of Witten-Herdecke makes use of income contingent loans that are collected world-wide.[42] So far, there seem to be no serious problems with money collection. This is especially true since well educated graduates typically emigrate to high income countries. These countries have legal regimes that allow for prosecution of debtors. And even if this would not be the case, emigrants could never return to their home countries if they default on their debts, otherwise they could easily be prosecuted. Taken together, there should be sufficient incentives not to default on one's debts.

Another observation is that subsidization under all three regimes differs across disciplines. This distorts individual choices of disciplines. Such a strategy could only be reasonable if there would be known relations between disciplines and externalities. But such knowledge does not seem to be available. Hence, the distortion of choices seems rather random.

What is most striking, though, is that despite the seemingly pronounced differences between tuition fee subsidization in Germany and the US on the one side and the Australian HECS on the other, the overall lifetime effects are almost identical. The difference in levels of subsidization is higher than the difference in overall patterns.

---

[42] See Witten/Herdecke University (2013)

5. Extensions

So far, we have mainly ignored some of the important aspects of higher education financing. We will now address some of these topics in a rather informal manner.

5.1. Incentives

There are basically two options to finance higher education, that is private financing or public financing. When the share of public funds increases, the incentives of obtaining higher education also increase. If more public funds are invested, the level of taxation must increase. But higher taxes reduce the incentives to obtain higher education and higher taxes reduce the incentives to work.[43] Of course, tuition fees also reduce the incentives to obtain higher education, but they do not reduce the incentives to work. However, if tuition fees have to be repaid on an income contingent basis with an income threshold, they could also be accompanied by reduced work incentives. However, the Australian HECS doesn't seem to have severe effects on work incentives. This may be due to the fact that in order to circumvent repayment, graduates would have to make sure that their income never exceeds the threshold income. But that's not what graduates typically have in mind when they start to study. So the overall picture is that tuition fees are better from the work incentive point of view even if tuition fees have to be reimbursed on an income contingent basis.

There are thus two opposing effects: Tuition fees reduce incentives to obtain higher education but provide better work incentives while tax financing improves incentives to obtain higher education but reduces work incentives. So which effect dominates?

First of all, the answer depends on the expected effect of shifting from taxes to tuition fees. The German system of higher education finance is purely based on taxes. Tuition fees are zero, but taxes are quite high. The German system of higher education is best characterized as a planned economy with phenomena of abundance and scarcity at the same time. Medicine is the most prominent example of extreme scarcity. The number of admissions is about 20% of applications. The "Abitur" is the German university entrance qualification. To get an admission for medicine, students need an A+ grade in their Abitur. At some universities, even this grade doesn't guarantee admission anymore.[44] Alternatively, students can get an admission by waiting for up to 6 years. Other disciplines have similar admission rules. This situation clearly suggests that there is no shortage of young people wanting to join the

---

[43] See Blundell / MaCurdy (1999) and Keane (2011) for a broad overview of studies concerning the effect of taxation on work incentives. For a recent survey see also Romer (2012).

[44] Pipos (2012)

universities. It is rather a shortage of supply. About 100.000 German students study abroad and in many cases pay tuition fees.[45] Taken together, there seems to be much room to introduce tuition fees without reducing the number of students and graduates. Under these conditions, a purely tax financed system is clearly inferior. The only incentive effect of the German financing system is thus the reduction of work incentives. There are other counterproductive effects as well, e.g. increased incentives for tax evasion or emigration to low tax countries.

Another effect, mainly ignored in the literature, is the effect of tax-financed higher education on work and education incentives for non graduates. If the system is financed by taxes alone, non-graduates are also held liable. This reduces their incentives to invest in their education and it reduces their incentives to work. These effects must not be ignored when estimating welfare effects.

Another aspect of purely tax-financed systems is that these systems distort preferences about disciplines. This topic has already been mentioned above and will not be discussed in any more detail here.

5.2. Insurance

In a world of uncertainty, risk averse agents may not obtain higher education even if its effect on expected lifetime income is positive. There is thus a danger of underinvestment in higher education. In this case, tax-financed systems as well as income contingent loans may be better than purely ex ante private tuition fee regimes. If tuition fees have to be covered privately, funds can be lost if later incomes are not sufficient. Risk averse agents may thus be reluctant when it comes to paying for higher education ex ante.

Because of the negative implications of tax regimes discussed above, income contingent loans are a preferable option when it comes to tackling problems of risk aversion. Thus, the Australian HECS has the best insurance properties of the three regimes under consideration. However, HECS eventually can be improved. This is due to the fact that HECS prescribes relatively high repayment rates after graduation. The effect of these repayment rates is that the average graduate repays his income contingent loan in about 12 years. If repayment rates would be reduced while repayments would be stretched over a longer period of time, the

---

[45] Gardner (2011)

insurance properties would improve. For example, if a graduates becomes permanently disabled after having paid off his debt, he has paid a higher percentage of his lifetime income for tuition fees than someone without any health problems and higher lifetime incomes. Optimal insurance would reverse this pattern.

Beside improved insurance effects, the financing characteristics are likely to improve as well by stretching the repayment period. This is due to the fact that younger graduates typically earn less and have higher financial needs, e.g. for raising children or building houses. Since private loans carry much higher interest rates than public debt, stretching repayment periods shifts advantageous public interest conditions to private households. If this advantage does not exist and graduates are allowed to repay higher amounts as they like, prolongation does no harm in any case.

5.3. Profit sharing

If third parties invest in someone's human capital, this may be done on the basis of debt or equity capital. If repayments and interests are fixed, it is a form of debt capital investment. If the repayment is variable and depends on income, the contract closely resembles equity capital contracts. By such contracts, third parties become residual claimants with a share in profits and a share in losses. A typical private contract in the US is that students get a loan to pay tuition fees. Interest and redemption are fixed, so the contract is a debt contract. Under the Australian HECS society invests on a hybrid basis. While the maximum repayment is fixed, society shares in the losses in the case of a graduate's default. The German system of full public coverage of tuition fees is a debt contract with zero repayment. There is thus a complete coverage of losses with no sharing in profits.

Of course, under all three regimes there is also income taxation. Since income taxes have to be paid without upper bounds and death as the only time restriction, subsidizing tuition fees via taxes is actually an equity contract. With income taxation societies become residual claimants. Since income contingent taxation does not seem to destroy societies, it seems worthwhile to have a closer look at income contingent loans with unlimited repayment obligations. Under such a regime, income contingent loans would have to be paid until death with no upper limit. Thus, a graduate becoming a billionaire would eventually have to pay millions of dollars as repayments. Richer graduates would therefore subsidize the less

successful ones.[46] Such a design would be a hybrid between income contingent loans and graduate taxes. Since obligations are unlimited, such a regime would mimic a graduate tax. But the basic concept of a graduate tax doesn't provide for differentiated repayments dependent on the size of subsidies received. Under the basic design of a graduate tax, economist and physicians with the same incomes would have exactly the same obligations. Under the hybrid design, obligations would differ according to the costs. If medicine is eight times as expensive as economics, the physician would have to pay eight times the amount of the economist. For example, the economist would pay 0.5% of income and the physician would pay 4%. And the hybrid form differs from a graduate tax in that it is based on an individual debt contract and not on the tax system. The former design is superior because individual debt contracts are enforceable even in the case of emigration.

Unlimited payment obligations under an income contingent loan scheme may have another positive effect especially for low income countries. In low income countries the costs of producing higher education is typically less than the costs in high income countries. If these countries charge income contingent fees that cover total costs on the average, emigration will likely yield positive returns. For example, if in Bulgaria a physician can be educated for say 10% of his gross income (about €500 a month in 2012), charging 10% of income after his emigration to Germany (about €7.000 a month in 2012), would yield 14 times the amount needed to cover costs. Interpreted the other way round, each doctor that emigrates pays for the education of 13 others. Emigration would thus not be a hindrance to increasing participation in higher education, it would become a driving force.

5.4. Consumption

Income data worldwide reveal that graduates earn a wage premium over non-graduates. Spending money on higher education is thus an investment. On the other hand, most graduates enjoy their studies. At least ex post. But if higher education has consumption properties[47] as well as investment properties[48], there is even less justification for subsidizing students. If alumni, as they regularly do, marvel about having had the times of their life at university, this reveals preferences maybe better than anything else. But subsidizing people to have the best times of their life is hardly a welfare improving strategy.

---

[46] Glennerster (2003), 25
[47] Alstadsæter (2009), 9ff. Also see Jacob / McCall / Stange (2012), 23ff.
[48] Becker (1994), 29 ff.

5.5. Production functions

As early as 1776 Adam Smith has suggested that specialization highly improves productivity.[49] The empirical evidence for this observation is overwhelming. But if specialization is at the heart of productivity, any positive effect of graduates on societies may not be externalities in their classical sense but may rather be productivity effects of team production. Members of a society all specialize and specialization in an academic discipline is just one way to contribute to the productivity effects of team production. If higher education is rather interpreted this way, there may still be arguments to justify public subsidization. But before doing so, one should look out not only for effects of graduates on societies but also for effects of societies on graduates. The following table documents the incomes of specialized physicians across countries. The figures are 2004 Dollars of U.S. purchasing power parities.

Country	Compensation '000	Ratio to per Capita GDP
Netherlands	253,000	6.0
Australia	247,000	7.6
United States	230,000	5.7
Belgium	188,000	6.0
Canada	161,000	5.1
United Kingdom	150,000	4.9
France	149,000	5.0
Ireland	143,000	4.0
Switzerland	130,000	3.8
Denmark	91,000	2.9
New Zealand	89,000	3.6
Germany	77,000	2.7
Norway	77,000	1.9
Sweden	76,000	2.5
Finland	74,000	2.5
Greece	67,000	3.1
Portugal	64,000	3.5
Czech Republic	35,000	1.7
Hungary	27,000	1.7
Mexico	25,000	2.4
Poland	20,000	1.6

Table 3: Average Compensation of specialized physicians 2004[50]

A plot of the specialists' yearly incomes against GDP reveals the non-linear relationship in favor of the specialists. As GDP increases, their incomes increase disproportionally (see

---

[49] Smith (1776)
[50] Source: Peterson/Burton (2007), 18.

figure 9). If the univariate relationship is assumed to be exponential, the regression analysis yields an R^2 of 0.722. In contrast, the linear model yields only 0.57.
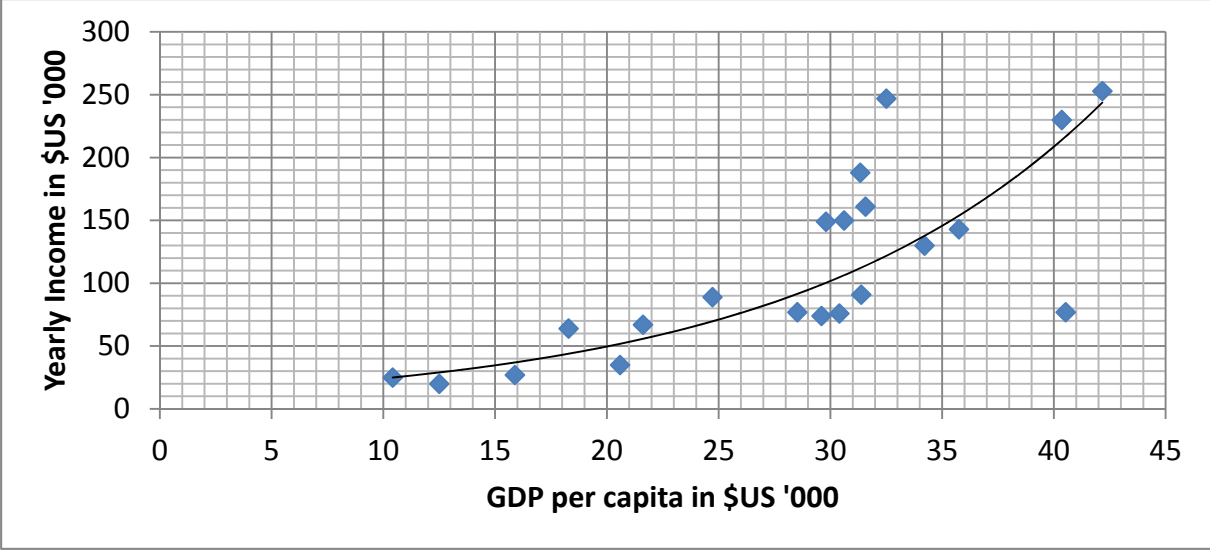

Figure 9: Income of specialized physicians against per capita GDP

The first impression from this plot is that graduates may highly profit from successful societies. This suggests that externalities may rather work the other way round, i.e. graduates are not the source of positive externalities, they may rather be the ones to enjoy positive externalities generated by societies.

5.6. Legal and economic shocks

Tax financed regimes of higher education may be faced with massive problems in the event increased mobility. Reasons for abrupt changes in mobility patterns may be changes in legislation or economic shocks. One recent example of potential problems due to changes in legislation is the liberalization of former travel restrictions in Cuba.[51] Cuban doctors were subject to severe travel restrictions for a long time, restrictions justified as necessary to prevent brain drain. Now these restrictions have been removed.[52] It will be interesting to see how emigration patterns will develop. In any case, with the travel restrictions gone, the doctors' bargaininig power in renegotiating their contracts with society has improved.

The European Union right now is a vivid example of the possible effects of economic shocks in a world without mobility restrictions. The massive economic downturn of Greece has

---

[51] Cave (2012)
[52] Rodriguez (2013)

triggered an unprecedented wave of emigration. Since Germany's economy is still quite strong and there is a shortage of physicians at German hospitals, Germany attracts many of the emigrants from Greece.[53] But the obvious other side of the coin is that lots of Greek hospitals become more and more inoperable. Although exact figures on medical doctors alone are not readily available yet, total emigration from Greece to Germany increased by 78% from the first half of 2011 to the first half of 2012 alone.[54] The financial constraints do not allow Greek hospitals to pay their doctors competitive wages. One Greek hospital has even been reported to have threatened to refuse a mother the right to her newborn child until she was able to pay for her treatment.[55]

A discussion of these mobility effects is beyond the scope of this paper, but it should be interesting to have a closer look at problems of ex post renegotiation about the rents of cooperation from team production. In the end this may lead to the conclusion that tax-financed systems of higher education could completely collapse. In this vein, Hungary has just changed its constitution: graduates that have received public funds are required to work in Hungary for some years after graduation.[56] If they leave Hungary before the deadline graduates are required to pay back such funds when leaving the country.[57]

---

[53] Detsch (2011)
[54] Statistisches Bundesamt (2012)
[55] CBS Local (2012).
[56] Flückinger (2013).
[57] Myklebust (2012)

6. Discussion and conclusions

The case for subsidizing higher education is more than weak. It is unclear whether higher education generates net positive externalities at all. And even if positive externalities do exist, it is unclear whether their extent is sufficient to justify subsidization. What is more, negative externalities of higher education have been completely ignored so far. Since potential negative externalities outweigh potential positive externalities by magnitudes, there may even be better reasons to suppress higher education than to subsidize it.

Another topic that is mainly ignored in the public debate on higher education is its consumptive properties. Whenever there are calls for more subsidization, proponents of these calls always emphasize the investment character of higher education. But these calls ignore that being a student is not only an investment, it is fun. Whenever alumni meet, the typically marvel about having the times of their life at university. But if studying is a consumption activity, there is no reason for subsidization anyway.

If subsidization seems reasonable nonetheless, the applied subsidization regimes seem more than questionable. None of them reclaims the full amount of subsidies from the highest income graduates, although subsidization of these individuals is neither necessary as an incentive to obtain higher education nor is it necessary to maintain work incentives. It is also rather striking that subsidies typically have not to be returned by emigrants. What is more, case insensitive subsidization via the tax system alone also distorts young peoples' choices of disciplines.

The overall picture is that levels of subsidization of higher education can be reduced heavily worldwide without any welfare losses and that there is much room for improvement of the design of subsidization regimes. The Australian HECS, although far from perfect, is a good blueprint where to start from. Some improvements are rather straightforward: The amount of repayments per year should be reduced but the payback period should be prolonged. This would improve the insurance properties of income contingent loans and it would be favorable from a liquidity point of view since incomes in the years after graduation are lower than in later years while financial demands are likely to be higher. And for high income graduates the total amount of repayments should be increased to the level of complete repayment at least. It may even be reasonable to charge a lifetime fee without an upper bound for highest income graduates. These graduates would thus subsidize other graduates with lower incomes. Such a design would be kind of a hybrid regime between income contingent loans and graduate taxes.

References

Acemoglu, Daron and Angrist, Joshua (1999): How Large are the Social Returns to Education? Evidence from Compulsory Schooling Laws, NBER Working Paper No. 7444, National Bureau of Economic Research, pp. 1-28.

Alstadsæter, Annette (2009): Measuring the consumption value of higher education, CESIFO Working Paper No. 2799, pp. 1-20

Appiah, Elizabeth N. and McMahon, Walter W. (2002): The Social Outcomes of Education and Feedbacks on Growth in Africa, In: The Journal of Development Studies, Volume 38, Issue 4, pp. 27-68.

Australian Government: Study Assist, available at http://studyassist.gov.au/sites/studyassist/helppayingmyfees/hecs-help/pages/hecs-help-welcome (February 27, 2013)

Barnett, Cynthia (2000): Measurement of White-Collar Crime Using Uniform Crime Reporting (UCR) Data, US Department of Justice, Federal Bureau of Investigation

Barr, Nicholas (1993): Alternative Funding Resources for Higher Education, The Economic Journal, Vol. 103, 718-728.

Becker, Gary S. (1994): Human capital: A theoretical and empirical analysis with special reference to education, University of Chicago Press.

Blöndal, Sveinbjorn and Field, Simon and Girouard, Nathalie (2002): Investment in human capital through upper-secondary and tertiary education, In: OECD Economic Studies 34, No. 1, pp. 41-89.

Blundell, Richard and MaCurdy, Thomas (1999): Labor supply: A review of alternative approaches, Handbook of labor economics 3, pp. 1559-1695.

Boy, Ann-Dorit (2013): Frau Doktor geht nach Deutschland, Frankfurter Allgemeine Zeitung, April 24, 2013, p.3.

Carlino, Gerald A. (2001): Knowledge Spillovers: Cities' Role in the New Economy, In: Business Review, Q4, 2001, pp. 17-24.

Cave, Damien (2012): Easing Path Out of Country, Cuba Is Dropping Exit Visas, available at http://www.nytimes.com/2012/10/17/world/americas/cuba-lifts-much-reviled-rule-the-exit-visa.html?pagewanted=all (February 27, 2013)

CBS Local (2012): Greek Hospital Threatens To Hold Newborn Until Payments Are Received, available at http://washington.cbslocal.com/2012/05/23/greek-hospital-threatens-to-hold-newborn-until-payments-are-received/ (April 2, 2013).

Chapman, Bruce and Ryan, Chris (2003): The access implications of income-contingent charges for higher education: Lessons from Australia, Centre for Economic Policy Research, Australian National University, pp. 1-37.

Chapman, Bruce (2006): Income Contingent Loans for Higher Education: International Reforms. In: Handbook of the Economics of Education, Vol. 2, chapter 25, pp. 1435-1503.

Chapman, Bruce and Tan, Michelle (2008): The Australian University Student Financing System: The Rationale for, and Experience with, Income Contingent Loans, In: EABER Working Paper Series 4, pp. 1-29.

Ciccone, Antonio and Peri, Giovanni (2006): Identifying Human Capital Externalities: Theory with Applications, Review of Economic Studies 73, pp. 381–412.

Coase, Ronald H. (1960): The Problem of Social Cost, In: Journal of Law and Economics, Vol. 3 (Oct.), pp. 1-44.

Cohen, Daniel and Soto, Marcelo (2007): Growth and human capital: good data, good results, In: Journal of Economic Growth, Springer, vol. 12(1), pp. 51-76

Dee, Thomas S. (2004): Are there civic returns to education?, In: Journal of Public Economics 88, pp. 1697-1720.

Detsch, Roland (2011): Brain Drain in Greece, available at http://www.goethe.de/lhr/prj/daz/mag/mig/en7677979.htm (February 28, 2013)

Duffy, Michael (2009): Weapons of War - Poison Gas, available at http://www.firstworldwar.com/weaponry/gas.htm (December 20, 2012)

Flückinger, Paul (2013): Ärztemangel in Polen führt schon zu Todesfällen. Available at http://www.derwesten.de/politik/aerztemangel-in-polen-fuehrt-schon-zu-todesfaellen-id7834768.html (May 12, 2013)

Friedman, Milton (1955): The role of government in education, R.A. Solo (Ed.), Economics and the Public Interest, Rutgers University Press, New Brunswick, NJ

Gardner, Michael (2011): Gernaby: Student mobility rising fast, study shows, In: University World News, available at http://www.universityworldnews.com/article.php?story=20110114222552395, (February 28, 2013)

Gerlach, Tanja (2012): Deutsche Ärzte zieht es ins Ausland, Hamburger Abendblatt, available at http://www.abendblatt.de/politik/deutschland/article110834665/Deutsche-Aerzte-zieht-es-ins-Ausland.html (February 28th, 2013)

Glennerster, Howard (2003): A graduate tax revisited, Higher Education Review, Vol. 35, pp. 25-40.

Granados, José A. T. and Ionides, Edward L. and Carpintero, Óscar (2012): Climate change and the world economy: Short-run determinants of atmospheric CO2, In: Environmental Science & Policy, Vol. 21, pp. 50-62

Greenaway, David and Haynes, Michelle (2003): Funding Higher Education in the UK: The Role of Fees and Loans, In: The Economic Journal 113, No. 485, pp. F150-F166.

Hanushek, Eric A., and Kimko, Dennis D. (2000): Schooling, labor-force quality, and the growth of nations, In: American Economic Review 90(5), pp. 1184-1208.

Harding, Ann (1995): Financing higher education: An assessment of income-contingent loan options and repayment patterns over the life cycle, Education Economics Vol. 3 No. 2, pp.173-203.

Heckman, James J. and Klenow, Peter J. (1997): Human Capital Policy; Mimeo, University of Chicago.

Isserstedt, Wolfgang and Kandulla, Maren (2011): Internationalization of Higher Education, Federal Ministry of Education and Research, Berlin

Jacob, Brian and McCall, Brian and Stange, Kevin (2012): The Consumption Value of Education: Implications for the Postsecondary Market, Working Paper.

Kane, John and Wall, April D. (2006): The 2005 National Public Survey on White Collar Crime, National White Collar Crime Center

Keane, Michael P. (2011): Labor supply and taxes: A survey, Journal of Economic Literature 49, No. 4, pp. 961-1075.

Krueger, Alan B. and Lindahl, Mikael (2001): Education for Growth: Why and for Whom?, In: Journal of Economic Literature, American Economic Association, vol. 39(4), pp. 1101-1136.

Lochner, Lance (2004): Education, Work, and Crime: A Human Capital Approach, In: International Economic Review, 2004, Vol. 45 (3), pp. 811-843.

Lochner, Lance (2010): Education and Crime, In: International Encyclopedia of Education (Third Edition), 2010, pp. 239-244.

Lochner, Lance and Moretti, Enrico (2003): The Effect of Education on Crime: Evidence from Prison Inmates, Arrests, and Self-Reports.

Mankiw, Nicholas G. and Taylor, Mark P. (2006): Microeconomics, Thomson Learning, London.

McMahon, Walter (2004): The Social and External Benefits of Education, In: International Handbook on the Economics of Education, Geraint and Jill Johnes, eds, Edward Elgar, Publishers, pp.211-259.

Moretti, Enrico (2004): Workers' Education, Spillovers, and Productivity: Evidence from Plant-Level Production Functions, In: The American Economic Review, Vol. 94, No. 3 (Jun., 2004), pp. 656-690

Myklebust, Jan Petter (2012): Students protest against introduction of tuition fees, University World News, Issue 252, Available at
http://www.universityworldnews.com/article.php?story=20121216063956634 (April 2, 2013).

National Center for Education Statistics (NCES) (2003): The Condition of Education 2003, Washington, DC: U.S. Government Printing Office

OECD (2012): Education at a Glance 2012: OECD Indicators, OECD Publishing.

Olmstead, Sheila M. and Muehlenbachs, Lucija A. and Shih, Jhih-Shyang and Chu, Ziyan and Krupnick, Alan J. (2013): Shale gas development impacts on surface water quality in Pennsylvania, Resources for the Future, Washington

Osborn, Stephen G. and Vengosh, Avner and Warner, Nathaniel R. and Jackson, Robert B. (2011): Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing. Proceedings of the National Academy of Sciences, Vol. 108, No. 20, pp. 8172-8176

Payne, Brian K. (2011): White-Collar Crime: A Text/Reader, Georgia State University, Sage

Pipos, Alexandra (2012): 97 Absagen: Abinote 1,0 reicht nicht für Medizinstudium an Uni Münster, available at http://www.muensterschezeitung.de/lokales/muenster/Abinote-1-0-reicht-nicht-fuer-Medizinstudium-an-Uni-Muenster;art993,1737792 (February 28, 2013)

Pritchett, Lant (2001): Where has all the education gone?, In: The World Bank Economic Review 15(3), pp. 367-391.

Rodriguez, Andrea (2013): Cuba to free doctors from onerous travel rules, Yahoo! News, Available at http://news.yahoo.com/cuba-free-doctors-onerous-travel-rules-193309069.html (April 2, 2013)

Romer, Christina D. and Romer, David H. (2012): The Incentive Effects of Marginal Tax Rates: Evidence from the Interwar Era, No. w17860, National Bureau of Economic Research.

Shavell, Steven (2004): Foundations of economic analysis of law, Harvard University Press.

Smith, Adam (1776): An Inquiry into the Nature and Causes of the Wealth of Nations

State University of New York (2012): 2012 Annual Financial Report. Available at http://www.suny.edu/sunynews/2012_AnnualFinancialReport.PDF (June 17, 2013)

Statistisches Bundesamt (2008): Verdienste und Arbeitskosten, Verdienststrukturerhebung, Fachserie 16, Heft 1, Available at https://www.destatis.de/DE/Publikationen/Thematisch/VerdiensteArbeitskosten/VerdiensteBerufe/Verdienststrukturerhebung2162501069004.pdf?__blob=publicationFile (November 29, 2012)

Statistisches Bundesamt (2011): Bildungsfinanzbericht 2011, Wiesbaden. Available at https://www.destatis.de/DE/Publikationen/Thematisch/BildungForschungKultur/BildungKult

urFinanzen/Bildungsfinanzbericht1023206117004.pdf?__blob=publicationFile, (April 2, 2013).

Statistisches Bundesamt (2012): Zuwanderung nach Deutschland steigt im 1. Halbjahr 2012 um 15%, Pressemitteilung Nr. 397 vom 15.11.2012, available at https://www.destatis.de/DE/PresseService/Presse/Pressemitteilungen/2012/11/PD12_397_127 11.html;jsessionid=3D405CE3E7A31C2F5BD9932DA49169CF.cae3 (April 2, 2013)

Soto, Marcelo (2009): The causal effect of education on aggregate income, pp. 1-24.

Tenn, Steven (2007): The effect of education on voter turnout, In: Political Analysis 15(4), pp. 446-464.

Thaidigsmann, Isabell (2004): Sozialstruktur und Wählerverhalten.

University of California: Budget Charts 2011-2012, available at http://budget.universityofcalifornia.edu/files/2011/11/UC_Budget_Charts_2011-12.pdf , (June 17, 2013)

World Bank: GDP, World Bank national accounts data and OECD National Accounts data files, available at http://data.worldbank.org/indicator/NY.GDP.MKTP.CD (February 27, 2013)

Weisbrod, Burton A. (1964): External Benefits of Public Education: An Economic Analysis, Princeton: Princeton University Press.

Witten/Herdecke University (2013): Tuition fees and payment, available at http://www.uni-wh.de/en/study/tuition-fees-and-payment/ (February 28, 2013)

Peterson, Chris L. and Burton, Rachel (2007): U.S. Health Care Spending: Comparison with Other OECD Countries – CRS Report for Congress, 17 September, 2007, available at http://assets.opencrs.com/rpts/RL34175_20070917.pdf (June 17, 2013)