Cost-benefit analysis in the case of university financing: theoretical framework and literature review

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Statutory Declaration

I hereby declare that the thesis submitted is my own unaided work, that I have not used other than the sources indicated, and that all direct and indirect sources are acknowledged as references. This printed thesis is identical with the electronic version submitted.

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Abstract

Since the tertiary education across the globe is mainly publicly financed, it is only reasonable to think about the rentability of the invested funds. While there are different approaches being used in the literature, the cost-benefit analysis is deemed as appropriate tool for evaluating the governmental project “university”. The aim of the thesis is to develop a theoretical framework that shows what information is necessary in general to conduct a cost-benefit analysis on universities. Furthermore, the possible benefits of both academic research and teaching are being identified. In a last step, those possible benefits are being compared to the findings of selected (partial) studies regarding this topic. As the results of the analysis show, the benefits of academic research are much more difficult to quantify than those of academic teaching. Furthermore, the findings of some of the selected other studies are not in accordance to a sound cost-benefit framework, overestimating the benefits and thus presenting universities in a much too bright light.
Abstract

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1 Introduction

Knowledge has always been the basis for innovation and for the development of the society as a whole. Since their creation, universities have been places of both knowledge preservation, by educating students, and of knowledge creation, by conducting research in many fields. Also, the contribution to social development and providing solutions to current social or industrial problems has become another core role of universities (their third mission) (Kapetanion and Lee, 2016). While the financing of universities differs across countries, on average 1.5% of the national GDP are spent on tertiary education. Two thirds thereof come from public funds (OECD Education at a Glance, 2017). Thus it is reasonable to think about the rentability of this investment from an economic viewpoint. The literature regarding this topic is extensive, especially for education in general (see for example Abhijeet 2010, Damon and Glewwe 2011, Devereux and Fan 2011, Dickson and Harmon 2011, Li et al. 2011).

However, the focus rarely lies on universities in particular and even less so on the benefits of the academic research efforts. Although it is widely accepted that academic research is vital for the economic and social development of a country, there is still a lack of proper evaluation methods. Some existing studies have already tried to identify and quantify the effects of universities (i.e. academic research and teaching) but eventually they managed to do so mainly for academic teaching (see Janger et al. 2017, Damon and Glewwe 2011, Frenette 2008, Kapetanion and Lee 2016). This already indicates the difficulty of evaluating (academic) research output. Furthermore, the current literature on this topic consists of partial studies with a narrow focus on a particular university, and on the other hand of more general studies which gather all the direct and indirect effects of universities. The latter approach, however, could lead to overestimated or biased results, as shall be explained later in this thesis.

One common tool for evaluating public projects is the cost-benefit analysis. Despite its limitations, governments and agencies rely on the framework’s results in support of decision making (Posner, 1999). Since the tertiary education across the globe is mainly publicly financed, one may think of a university as a governmental project. Thus, in the context of this thesis, the conceptual framework of a cost-benefit analysis shall be applied to the case of universities. The aim is to develop a theoretical framework that shows what information is necessary in general to conduct a cost-benefit analysis on universities. Furthermore, the possible benefits of both academic research and teaching are being identified. In a last step, those possible benefits are being compared to the findings of selected (partial) studies regarding this topic. This analysis shall show whether the authors comply to the concept of a cost-benefit analysis or not, and how this affects their results in terms of accuracy and explanatory power. By doing so, this thesis shall help to understand the different viewpoints and shall give a clearer structure of the current debate about public funding of universities.
The structure of the thesis is as follows: in Section 2 the general concept of cost-benefit analysis, as well as some limitations and critique, are presented in detail. Then Section 3 looks at some descriptive figures in the context of tertiary education (and its financing) around the globe. This shall provide a bigger picture and complete the discussion. The core of this thesis, Section 4, then elaborates on the possible benefits from both academic research and teaching, distinguishing between the disciplines in terms of their link to a practical use. Next, some selected studies by other authors are analyzed and their results compared to the ones under cost-benefit analysis. Finally, Section 5 contains some concluding remarks and outlooks for further research.
2 The Cost-Benefit Analysis

2.1 Definition and assumptions

In a world of scarce resources, both private firms and governments should aim to make the most efficient investment decisions in order to maximize rentability. This requires a reliable evaluation method of the possible investment choices, that not only estimates their feasibility but also makes the options comparable.

In the private sector this is often done in an investment analysis, whereas the public sector makes use of the cost-benefit analysis. The main idea of both is to see whether the benefits of an investment out-weight the associated cost, deeming it acceptable if this is the case. Both tools appear quite similar at first glance, yet there are some distinct differences especially in practice. The cost-benefit analysis takes on a much broader view concerning the benefits and costs of a project or investment and the quantification of those is much more difficult. Due to the lack of market prices, estimations of the consumer’s willingness to pay for the benefits have to suffice in many cases (Brunner, 2018). As discussed later in this section, even the estimation of incurred costs and especially benefits is not as straightforward as for private investments. Difficulties start with the general notion of the cost-benefit analysis and also extend to the practical application. Examples of governmental projects range from the building of bridges and tunnels to the funding and provision of education. They all have in common that the individuals financing these projects (indirectly via taxes) are not necessarily identical with the beneficiaries. In fact, there are several different groups of beneficiaries with often disaccordant interests. Whenever evaluating a project it is thus important to consider its effects on each of those groups as well as its redistributive effects (Tresch, 2008).

The concept of cost-benefit analysis builds on a set of key assumptions, some of which are rather standard in economic models. One of them was mentioned at the very beginning of this section: the scarcity of resources. In addition it is assumed that the economy operates at maximum capacity and under full employment. This implies that all resources are always being put to some use and that there are no excess resources for wasteful ventures available. The resulting competition of resources for governmental funds is reflected by the assumption of full employment, which also helps to determine their most efficient use. If there is some unemployment, the implementation of a governmental project could create a demand for workforce as a counter measure – but any governmental expenditure or higher private consumption and investments would. It follows logically that an employment effect can hardly be attributed to one distinct governmental project, let alone be compared to the effects of other possible alternatives. Thus it seems reasonable to focus on the effects related specifically to the studied project and to assume full employment (Tresch, 2008).
Consequently, these assumptions demand that any governmental use of resources has to be at least as profitable as when the resources were left in the private sector. The resources needed for a governmental project come at the cost of the forgone use on other projects or in the private sector and this approach labels opportunity costs as the true costs in a cost-benefit analysis (Brunner, 2018). Costs could arise as negative willingness to pay of households who suffer from negative consequences of the governmental project, e.g. noise of a highway (Brunner, 2018). The most important part of the costs occurs upfront at the initiation of the project (Kingston, 2001) and is usually evaluated at market- or shadow-prices in the case of imperfect markets (Brunner, 2018).

Unfortunately, the many kinds of benefits associated to a public project do not occur upfront, nor can they be evaluated straightforward at market- or shadow-prices. The concept of cost-benefit analysis defines benefits as the additional profits for firms or as the additional gains for households due to the governmental expenditure. Those gains are typically reflected by the (marginal) willingness to pay of a household. An aggregation thereof gives the consumer rents as standard measure for the sum of the benefits on the households’ side (Brunner, 2018).

However, some benefits are well hidden or arise as a side-effect of the governmental action. Often there is no practical way to find the required information to evaluate their magnitude. In fact there are a number of situations when the evaluation of benefits (and sometimes also costs) at market-prices becomes difficult. The next paragraphs about some of those special cases follow Tresch (2008):

**Intangibles and non-marketed benefits**

Even if they are obvious, intangible benefits (or costs) cannot be quantified in any reasonable way. Such benefits could be the national security provided by armed forces, the positive social effects of a community’s own soccer team or the unknown long-term effects of environmental changes. Another example would be the research output of certain disciplines (see Section 4). Those are all benefits without a clear market value due to the vague and uncertain nature of the benefits. Another distinct characteristic of public projects is that incurred benefits are mostly given away for free because decreased service costs or triggered technological externalities are the main goal (instead of profits). There is no fee for using a public park nor are there marginal costs of another individual doing so. Likewise the externalities, for example clean air due to environmental policies, are not priced. This relates to the common attributes of public goods: non-excludability and non-rivalry. Quantifying such non-marketed benefits requires finesse and Tresch (2008) mentions three possible approaches to do so: evaluating the source of the benefits, hedonic price estimation and contingent valuation. However, these methods shall not be discussed further in this thesis.
Lumpy investments

In contrast to private investments, governmental ones tend to be of a much greater scale and therefore often change the current market conditions. Especially prices alter and supply shifts upwards as a consequence of such “lumpy” governmental investments. For example, electricity becomes cheaper if a new wind farm is built. Tresch (2008) names the Hick’s compensation variation (HCV) or the Hick’s equivalent variation (HEV) as proper measuring tools for such effects.

Shadow prices

In practice, markets are often distorted (e.g. by taxes) and as a consequence there is a divergence between the price that consumers and producers face for the same good. When conducting a cost-benefit analysis, such distortions should be considered in the quantification of costs to achieve more accurate results. Economists use the so-called shadow prices for a project’s marketed inputs and outputs that come at the expense of private production and consumption. Depending on the underlying assumptions, the formula for the shadow price varies across models (and authors). One approach is the weighted average: in the first step, the average of the prices for a factor (in- or output) faced by consumers and producers is taken. Then this average is weighted by the proportional use of this factor for the project. In general, however, the shadow price could be defined as the producer price, adjusted by the change in deadweight loss that is caused by a marginal change in governmental production.

For some type of governmental projects (e.g., universities, research facilities) it is convenient to additionally divide the benefits in use- and non-use-benefits. The first category refers to benefits that arise through a direct use of the products and services provided by the governmental project. In contrast, non-use benefits stem from the provision of those products and services per se, without actually using them (Florio et al., 2016). Examples in the context of universities is given in later sections. Given these tricky issues concerning benefits, the task of evaluation requires creativity and methodical finesse from the analyst.

2.1.1 The time value of money

Now that the costs and benefits are defined and the difficulties in their estimation are made clear, another issue needs to be mentioned before turning to the actual set-up of the cost-benefit analysis. When comparing costs and benefits it matters at which point in time these occur. A dollar today is not a dollar one year from now. One reason for this is inflation, which debases currencies over time. Another reason is the general uncertain nature of the future that assigns some probability to outstanding payoffs or impending costs. Input factor prices could deviate or general conditions of a project could change in a substantial way in future periods. As for the public sector, governments could be reassigned and the new politicians may discard the projects of their predecessors. This all adds to the uncertainty of the presumed benefits of a project.
Yet even when there is no uncertainty about the future payoffs, a dollar today is typically preferred to one dollar paid out in one year. Money received today can be invested or saved and, depending on the interest rate, could yield a higher return after one year compared to receiving the initial sum at that later point in time. Following this logic, money has different values across time and needs adjustment to be comparable. There are two possible ways for this purpose:

- **Discount to present values**: this method gives the current value of money received in future periods. Consider a payoff of $X$ one year in the future (end of period $t_1$) at an interest rate of 8%. Its present value at the end of period $t_0$ is $X \frac{1}{(1+0.08)}$. The present value will always be smaller than the future value of money, hence this method is called discounting.

- **Compound to future values**: this can be understood as the opposite technique to the one above. The current value of an payoff $A$ can be transformed into its future value (for the time of one year) by calculating $A \times (1 + 0.08)$.

For the cost benefit-analysis, which takes a today viewpoint, it is more useful to apply the discounting technique rather than compounding to future values. Thus all the occurring costs and especially the benefits of a project need to be discounted to present values before comparing them. The fact that money differs in its value across time is important in the context of evaluating projects because benefits tend to evolve some time after the initialization of the project. For private or firm investments, this is especially true for accumulating capital, which is durable and can generate a stream of payoffs long into the future. As for governmental projects, the logic applies to benefits reaped later in time, for example the positive effects on people’s health of anti-smoking laws. The very nature of governmental projects as well as their scale lead to benefits that often occur in future periods, which justifies the necessity of discounting to present values.

### 2.2 The standard procedure of a cost-benefit analysis

Now the actual process of conducting a cost-benefit analysis comes into focus. In general, albeit the above mentioned difficulties, the ideal steps are as follows (Kingston (2001), Florio et al. (2016)):

1. Definition of the project’s scale and goals
2. Identification of financial or environmental constraints
3. Listing of alternatives and definition of the counterfactual scenario (without the project)
4. Determination of costs and benefits
5. Evaluation of costs and benefits
6. Calculation of the project’s net present value
For a sound cost-benefit analysis it is important to compare the project’s benefits with the counterfactual scenario in order to determine whether those benefits are directly linked to the initiation of the project. If so, then only this incremental benefit should be estimated and included into the analysis (Florio, 2016). In the last step, the so-called net present value formula is used, which constitutes the basis of any cost-benefit analysis (Kingston, 2001):

\[
NPV = \sum_{t=0}^{T} \frac{(B_t - C_t)}{(1 + R)^t} > 0 \tag{2.1}
\]

with the incurred benefits \(B_t\), the costs \(C_t\) and the public discount rate \(R\). For all time periods, the quantified costs are subtracted from the quantified benefits and all terms are discounted. The sum gives the net present value \(NPV\). Since the time horizon \(T\) starts at the current period, benefits or costs that occur at the very beginning of a project are considered as well. The net present value can be interpreted as the total social gain from a project, net the necessary costs (Kingston, 2001).

Before turning to the decision rule, it is worth defining the public discount rate in more detail. How should future benefits and costs be evaluated today? Of course, if total costs occur upfront and the value of all future benefits can be quantified in consumers’ willingness to pay today, the discount rate can be omitted. However, as mentioned before, benefits of a governmental spending tend to evolve over time and have to be discounted to present values. Throughout the literature, the public discount rate is highlighted as a very important variable in the cost-benefit analysis. The numerical magnitude of the benefits – and hence the net present value per se – depend on the chosen value of the discount rate (see Posner (1999), Tresch (2008), Kingston (2001), Florio et al. (2016)).

The public rate of discount as it is used in the net present value formula relates to the opportunity cost approach mentioned in the beginning of this section. Since government spending crowds out private consumption and/or investment, the governmental spending should be at least as profitable as private investments and private savings. Only then are the forgone private consumption and investments in favor of the governmental project justified. Following this logic, an appropriate public discount rate would be a mixture, perhaps a weighted average, of the gross interest rate for private investments and the net interest rate for private savings (i.e. forgone consumption) (Tresch, 2008). Still it is important to keep in mind how the choice of the discount rate influences the overall outcome of the cost-benefit analysis. A too high discount rate distorts the results by favoring projects with early benefits and by increasing the number of projects with a negative net present value. Thus one may calculate the net present value using slightly different discount rates each time, for a more profound analysis (Tresch, 2008).

### 2.2.1 Decision rule of a cost-benefit approach

Imagine that all relevant costs and benefits of a governmental project could be both identified and quantified, and the public rate of discount be estimated properly, so that all these ingredients give a calculation of the net present value. Then the concept of the cost-benefit analysis suggests to deem a project worthwhile if the social gains exceed the social costs, i.e. if \(NPV > 0\). In the
likely case that several mutually exclusive alternatives have a positive net present value, the one with the highest social gain is to choose (Brunner, 2018). This rule follows the idea of a potential Pareto improvement, or the Hicks-Kaldor test, meaning that a project should be accepted only if the net benefits are of such magnitude that losers could be compensated for their losses. Here the transfer cost of money are assumed to be zero. This possible redistribution would lead to some individuals being better off, while no one would be worse off after the implementation of the project – thus a possible Pareto improvement. For a project to be considered worthwhile, the compensation is not mandatory but it has to be possible (Copp, 1987).

As Kingston (2001) illustrates, the nature of the net present value formula implies that presumably large future benefits and costs lose their importance when discounted to present values. This means that early costs and benefits have a higher impact on the overall social profitability of the project, as it is perceived by the concept of the cost-benefit analysis. This notion seems reasonable since payoffs in the future tend to be more uncertain and volatile than the ones today. To consider this uncertainty in the net present value formula helps to generate a more accurate view on the rentability of governmental projects.

Of course, there are other ways to decide whether a project is worthwhile or not. Possible alternatives for the net present value rule are the internal rate of return or the payback period, but they also come with flaws. The internal rate of return, short IRR, is defined as the rate which equalizes the present value of both costs and benefits. It can be expressed as (Kingston, 2001):

$$\sum_{t=0}^{T} \frac{C_t}{(1 + IRR)^t} = \sum_{t=0}^{T} \frac{B_t}{(1 + IRR)^t}$$ (2.2)

The decision rule here is to accept a project if the internal rate of return exceeds the social discount rate, that is if $IRR > R$. However, the IRR approach looks at the returns per unit of investment and doesn’t consider the total gains from a project. Hence the ranking of projects may differ considerably from the one generated by using the net present value rule. Also if the sign of the net benefits oscillates across time periods, the calculation of a reasonable (let alone unique) IRR becomes very difficult. This volatility of results when using the IRR hampers the comparison of projects as well as the explanatory power of the whole analysis (Kingston, 2001). As for the payback period approach, the idea is to look at the time until the initial costs are offset by the benefits of the project. Then the project with the shortest payback period is chosen. Obviously, this method favors short-term projects with early benefits, which does not fit to the nature of governmental projects which tend to create benefits in future periods (Kingston, 2001). For these reasons, the net present value formula remains a popular choice for a cost-benefit analysis (Florio et al. 2016, 2016a).


2.2.2 Common pit-falls in practice

Since costs and benefits are not always easy to identify, let alone evaluate, in practice, a few likely error sources when conducting a cost-benefit analysis shall be mentioned here. Usually there is a lot of political debate, and perhaps some propaganda involved in the promotion of a governmental project. Naturally, supporters will present the same project rather differently, from another perspective or by highlighting distinct effects, as compared to the critics. Be it for this purpose or simply because of nescience about the true effects of a project, bogus costs and benefits are often added – sometimes even highlighted the most to underline the rentability of the project, especially when those doubtful benefits are of a large scale. As tempting as it might be, the inclusion of false benefits and costs to the analysis can distort the results and could lead to socially undesirable decisions, as well as an inefficient use of resources (Tresch, 2008).

The first possible error source is the inclusion of regional multipliers, or so-called secondary benefits. These are typically support services for the actual governmental project. Depending on the size of the project and the number of construction workers, whole infrastructures can emerge along-side. Restaurants, supermarkets, hotels etc. might sprout in a former rural region. However, these secondary benefits should not be considered in a cost-benefit analysis, since they are not part of the net benefits to the entire society. Key to this argument are the standard assumption of full employment and the notion of opportunity costs in cost-benefit analysis. Those imply that resources used for the secondary benefits in this one region come at a loss of resources elsewhere. And under full employment, these (secondary) losses roughly offset the secondary benefits. In fact, even with unemployment, the secondary benefits would arise due to any governmental expenditure of about the same scale and therefore, can’t be assigned to one particular governmental project (Tresch, 2008).

Another common pit-fall in practice is to treat the salaries of the project’s workers as relevant benefits. Again it is tempting to shift a significantly large part of the costs over to the benefits-side. Yet again the assumption of full employment implies that those workers would find a job elsewhere, salaries would be earned and the consequential taxes would arise regardless. According to Tresch (2008), salaries of the project’s workers should never be considered benefits, even if the workers would be unemployable otherwise – which is an unlikely scenario in his view. Similar to the regional multipliers, one can argue that the unemployed (otherwise unemployable or not) would find a job because of any governmental project of the same size (Tresch, 2008).

Finally, when defining relevant benefits is especially challenging for a distinct project, analysts may accidentally double count the ones they find. This is best illustrated by an example: if a new highway is built the residents will suffer from some negative externalities (noise, polluted air) and the market prices of their homes will most likely drop to mirror those negative externalities. However, only one of those losses can be added to the cost-benefit analysis, because people have a choice to make. Either they stay and suffer the noise or they move away and sell their homes for the adjusted price. In each case, the loss remains the same and including both options in the analysis would be pure double counting that results in an overestimation of the overall loss due to the governmental project (Tresch, 2008).
In order to avoid socially undesirable decisions, the analyst needs to be well aware which benefits should or should not be included, even if the valid ones are more difficult to quantify for various reasons (see above). Florio et al. (2016) suggest to be cautious and exclude overly uncertain benefits entirely from the cost-benefit analysis, in order to get perhaps underestimated but at least sound results.

2.3 Historical background

In order to present a complete picture of the cost-benefit analysis, a quick detour to its historical roots is being taken here. Today’s concept of the cost-benefit analysis emerged from three distinct historical developments. Firstly, many countries strengthened their central governments during the twentieth century. At that time, cost-benefit analysis gained more and more popularity among administrative agencies. Secondly, the spread of the Progressivism at the beginning of the twentieth century added another boost to the acceptance of cost-benefit analysis. Supporters of the Progressivism believed that society could be improved through reforms and they also differentiated between the politicians, biased by their norms and values, and the clean body of administration that employed scientific principles for their decisions. Thirdly, the early welfare economists and the new field of modern welfare economics supported those principles. In their view, any governmental action could be improved by the rationality of economic theory. Between 1950-1960, cost-benefit analysis was revised and formalized by economists and governments in various countries (Posner, 1999).

Over the course of the twentieth century, the cost-benefit analysis established itself as a standard tool for governments and administrative agencies despite its limitations. The alternatives just weren’t appealing and the cost-benefit analysis promised superior results. Those results could be used as justification for or against a governmental project and the public could be more easily convinced whenever the benefits exceeded the costs. It was a reasonable and simple way to silence the critics of a project. Only in 1970, however, the known difficulties of the cost-benefit framework became too present in the practical use and the utilitarian tint didn’t match the political spirit of that time. Similar like today, the analysts faced problems when evaluating certain benefits (e.g environmental resources, human life) and the vague estimations didn’t suffice as proof for the project’s rentability. The reemergence of the cost-benefit analysis can be dated to somewhere between 1980 and 1990, although it suffered from unsolved problems. However, the valuation methods have most likely improved and the utilitarian tint was no longer an issue. Since then the framework has been used as legitimate tool to support decision making on governmental spending (Posner, 1999).

2.4 Critique and limitations

There are some distinct limitations to the cost-benefit framework and the most pressing ones shall be discussed in this section of the thesis. Aside from the practical difficulties in quantifying the relevant costs and benefits, there are some other points of critique which one should bare in mind when conducting a cost-benefit analysis. According to Posner (1999), the critique on cost-benefit analysis is very fragmented. On the one hand there are moral objections against the evaluation
of especially intangible benefits, which affect the personal well-being for example. On the other hand, some critical economists admonish that cost-benefit analysis lacks a consistent ordering of projects and that the framework is often biased by the analysts norms and values. Posner (1999) further elaborates that most of the critique is directed towards the standard-textbook cost-benefit framework, which is often not what governments (or agencies) use in practice. Naturally, governments employ cost-benefit analysis under certain individual assumptions, they depart from the standard framework without much explanation, or they (accidentally) do not include particular benefits – the common pitfalls of cost-benefits. Thus, it is important discuss cost-benefit analysis as it is used in practice and to compare it with its neat textbook version, in order to gain insights into the still very persistent difficulties (Posner, 1999).

As mentioned before, the net present value formula discounts future benefits and costs. Here, the importance of early and future benefits depends heavily on the magnitude of the discount rate. A too high rate implies that more decisive weight is given to early benefits, whereas the opposite is true for a low discount rate. Large gains to society, perhaps for the next generations, do matter and it is important to assess their value in comparison to today’s costs. With a too high discount rate, projects with early benefits are favored and the interests of future generations perhaps neglected (Kingston, 2001). On the other hand, however, uncertainty about the future and the time value of money justify a more rigorous discounting to present values. Too much emphasis on future benefits resembles building on sandy ground. Thus Florio et al. (2016) even suggest to set the value of highly uncertain benefits to zero. Obviously, the choice of the discount rate is far from trivial and can have a large influence on the results of the overall analysis. Thus it is perhaps wise to conduct the analysis with several slightly different discount rates in order to gain a broader picture and to strengthen the explanatory power of the results.

Another important issue is that distributional aspects are not being considered in cost-benefit analysis. In fact, this seems to be a very common and hard critique. Defenders of the cost-benefit analysis reply that the initial purpose and the overall aim of this approach is rather to focus on an efficient use of resources, separated from questions concerning distribution. Efficiency can be evaluated and measured impartially while the value-laded decision about compensation of the losers remains for the politicians to make (Posner, 1999). From a methodological viewpoint, there is no flaw in evaluating first whether a project is worthwhile without looking at distributional effects. Those are being considered in a second step that is only reasonable if the benefits exceed the cost. If a project has a negative net present value, one need not bother with distributional effects anyway (Damon and Glewwe, 2011).

Still the distributional aspects of a project are not to be ignored and can be found in the potential Pareto-improvement notion of the decision rule for worthwhile projects, as discussed above. A project is deemed worthwhile if the benefits exceed the costs so that individuals who are now worse-off could be compensated, thus a potential Pareto-improvement. Nevertheless, critics stress the injustice that any cost-benefit analysis suffers from. They argue that there is no consideration about which societal group reaps the benefits and, more importantly, that cost-benefit analysis favors projects that put richer individuals better-off than the poor. This flaw stems from the basic concept to evaluate the cost and especially benefits as individual’s
willingness to pay (or compensating variations). According to critics, the willingness to pay depends heavily on the individual endowment. Rich people are not only capable of paying more to gain a benefit (or avoid a loss) but they probably are more willing to do so because the spent money has less opportunity costs for them. Thus, to treat the willingness to pay of rich and poor individuals equally means to implicitly assign a higher weight to the willingness to pay of rich people. Hence this is considered as the root of injustice in cost-benefit analysis (Copp, 1987). And ignoring such injustice would be against social morale, given that both governmental and private decisions are guided by moral values (Blackorby and Donaldson, 1990).

A standard defense against these harsh accusations is to apply weights to the willingness to pay that reflect the marginal utility of money at peoples’ different income levels. The willingness to pay of a poor is assigned with a higher weight, given that his or her opportunity costs are also higher, as compared to a rich person. This way the bias of cost-benefit analysis in favor of the wealthier could be lessened, if not avoided. However, finding such weights is not an easy task either and only adds to the already considerable difficulty of the analysis (Copp, 1987). A rational assumption, under which the equal treatment of money regardless the individual income is acceptable, would be that of costless lump-sum taxes or monetary transfers by the government in order to maximize social welfare. Any moral injustices or imbalances between the benefits received by the rich and the poor could be diminished (Blackorby and Donaldson, 1990).
In this context, Posner (1999) mentions that in some cases a clear separation of efficiency and distribution is not achievable, because both have interconnected effects. This so called “Scitovsky Paradox” stems from the idea that consumers’ preferences change as their wealth changes and that consumers value a project differently after its implementation (i.e. the willingness to pay is not the same as before the project). In some cases the paradox can lead to a higher preference of individuals for the status quo after the project has been implemented, than the preference for the project-state a priori in the status quo (Posner, 1999).

Distribution and social fairness are broad and complex topics on their own, and a more detailed exploration would be beyond the scope of this thesis. In the context of cost-benefit analysis, distribution comes into play after the actual numerical analysis, when politicians and different interest groups engage in decision making.

Despite the heavy critique and its limitations, the cost-benefit analysis remains a feasible and useful tool to aid in the process of decision making. It does not claim to yield the ultimate, unique solution to social challenges (Posner, 1999). Yet by providing a good overview of the feasible projects and their rentability, the cost-benefit analysis is a valid support for politicians. So far, there seems to be no adequate alternative method to evaluate public projects. Without a quantitative guideline regarding the expected costs and benefits, the financing decision is reduced to a political based on personal opinions and lobbying.
3 Financing of universities across the globe

In general, there are various reasons for the government to invest into education, which are all frequently mentioned. Increased economic growth, productivity and enhanced social development are just some examples thereof. A more detailed discussion of the benefits of (tertiary) education can be found in the next section. Now the financing of education and research in various countries shall be examined in order to understand the involvement of the state and furthermore, the necessity to discuss the financing from an economic viewpoint.

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<th>Country</th>
<th>Expenditures on Education</th>
<th>Expenditures on R&amp;D</th>
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<tbody>
<tr>
<td></td>
<td>Primary %</td>
<td>Secondary %</td>
</tr>
<tr>
<td>Australia</td>
<td>1.8</td>
<td>2.0</td>
</tr>
<tr>
<td>Austria</td>
<td>0.9</td>
<td>2.2</td>
</tr>
<tr>
<td>Belgium</td>
<td>1.6</td>
<td>2.8</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>0.8</td>
<td>1.9</td>
</tr>
<tr>
<td>Denmark</td>
<td>2.1</td>
<td>2.7</td>
</tr>
<tr>
<td>Estonia</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Finland</td>
<td>1.4</td>
<td>2.6</td>
</tr>
<tr>
<td>France</td>
<td>1.2</td>
<td>2.6</td>
</tr>
<tr>
<td>Germany</td>
<td>0.6</td>
<td>2.2</td>
</tr>
<tr>
<td>Hungary</td>
<td>0.6</td>
<td>2.0</td>
</tr>
<tr>
<td>Italy</td>
<td>1.1</td>
<td>1.9</td>
</tr>
<tr>
<td>Japan</td>
<td>1.3</td>
<td>1.7</td>
</tr>
<tr>
<td>Latvia</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1.2</td>
<td>2.4</td>
</tr>
<tr>
<td>Norway</td>
<td>2.1</td>
<td>2.4</td>
</tr>
<tr>
<td>Poland</td>
<td>1.6</td>
<td>1.7</td>
</tr>
<tr>
<td>Portugal</td>
<td>1.8</td>
<td>2.7</td>
</tr>
<tr>
<td>Slovenia</td>
<td>1.7</td>
<td>1.9</td>
</tr>
<tr>
<td>Spain</td>
<td>1.3</td>
<td>1.7</td>
</tr>
<tr>
<td>Sweden</td>
<td>1.7</td>
<td>1.9</td>
</tr>
<tr>
<td>Switzerland</td>
<td>1.5</td>
<td>1.9</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>2.0</td>
<td>2.8</td>
</tr>
<tr>
<td>United States</td>
<td>1.6</td>
<td>1.9</td>
</tr>
<tr>
<td>OECD average</td>
<td>1.5</td>
<td>2.1</td>
</tr>
</tbody>
</table>

Table 3.1: Total expenditures on educational institutions as a percentage of GDP, by level of education, and gross domestic expenditures on R&D as percentage of GDP, in 2014; Source: OECD Education at a Glance 2017, OECD Statistics
While the financing of primary and secondary levels of education depends heavily on demographic changes (i.e. population), the financing of the tertiary level does not. Education at this level is not mandatory but is an individual decision or a privilege for those better off. Generally for most European countries, the expenditures on the tertiary level account for about one third of overall expenses for educational institutions.

<table>
<thead>
<tr>
<th>Country</th>
<th>Public %</th>
<th>Private %</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>0.7</td>
<td>1.1</td>
<td>1.8</td>
</tr>
<tr>
<td>Austria</td>
<td>1.6</td>
<td>0.1</td>
<td>1.7</td>
</tr>
<tr>
<td>Belgium</td>
<td>1.3</td>
<td>0.1</td>
<td>1.4</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>1.0</td>
<td>0.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Denmark</td>
<td>1.6</td>
<td>0.1</td>
<td>1.7</td>
</tr>
<tr>
<td>Estonia</td>
<td>1.7</td>
<td>0.2</td>
<td>1.9</td>
</tr>
<tr>
<td>Finland</td>
<td>1.7</td>
<td>0.1</td>
<td>1.8</td>
</tr>
<tr>
<td>France</td>
<td>1.2</td>
<td>0.3</td>
<td>1.5</td>
</tr>
<tr>
<td>Germany</td>
<td>1.1</td>
<td>0.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Hungary</td>
<td>0.7</td>
<td>0.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Italy</td>
<td>0.7</td>
<td>0.2</td>
<td>1.0</td>
</tr>
<tr>
<td>Japan</td>
<td>0.5</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Latvia</td>
<td>1.1</td>
<td>0.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1.2</td>
<td>0.5</td>
<td>1.7</td>
</tr>
<tr>
<td>Norway</td>
<td>1.6</td>
<td>0.2</td>
<td>1.7</td>
</tr>
<tr>
<td>Poland</td>
<td>1.2</td>
<td>0.1</td>
<td>1.3</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.9</td>
<td>0.5</td>
<td>1.4</td>
</tr>
<tr>
<td>Slovenia</td>
<td>1.0</td>
<td>0.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Spain</td>
<td>0.9</td>
<td>0.4</td>
<td>1.3</td>
</tr>
<tr>
<td>Sweden</td>
<td>1.5</td>
<td>0.2</td>
<td>1.7</td>
</tr>
<tr>
<td>Switzerland</td>
<td>1.3</td>
<td>–</td>
<td>1.3</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>0.6</td>
<td>1.3</td>
<td>1.8</td>
</tr>
<tr>
<td>United States</td>
<td>0.9</td>
<td>1.7</td>
<td>2.7</td>
</tr>
<tr>
<td>OECD average</td>
<td>1.1</td>
<td>0.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Table 3.2: Total expenditures on educational institutions as a percentage of GDP, by source of funding, in 2014, Source: OECD Education at a Glance 2017

Table 3.1 gives an overview of the total (private + public) expenditures on educational institutions across various countries. The index is measured as a percentage of GDP by the level of education (primary, secondary and tertiary) (following OECD Education at a Glance, 2017). The OECD average of expenditures on the tertiary level lies at 1.5 % and while the values for most European countries diverge by 0.1-0.4 percentage points, the U.S. spends 2.7 % of GDP on tertiary education. The variation depends on the number of universities and other factors, like the amount of expenditures spent on research and development. In 2014, the countries with the highest gross domestic spending on R&D are Japan, Finland and Sweden with 3.4%, 3.2% and 3.2% of GDP respectively. The OECD average lies at 2.4% of GDP. Gross domestic spending on R&D includes all expenditures on R&D conducted at resident companies, research institutions, universities and governmental laboratories. The sources of the funds are domestic or from abroad. Domestic expenditures on R&D conducted abroad is excluded.
When looking at the expenses on the tertiary level, it is also interesting to see how those are financed (see Table 3.2). A higher level of education is to a large extent publicly financed in most European and northern countries. In contrast, individuals need to fund their own education (e.g. tuition fee loans) in the U.S, the United Kingdom, Australia and Japan. As a matter of fact, there is a vivid current discussion about the financing of tertiary education in many countries. In general, the need for highly-skilled employees in different industries, as well as the diversity of providers of education, cause governments to struggle with the financing. While one could claim that education should be available to everyone (and thus implicitly demand public financing), it is just as reasonable to demand that those individuals who benefit the most from tertiary education also cover a share of the costs. This, however, allows for questions about equity among households and their access to education. And it is certainly not in a country’s best interest to drive potential students away from tertiary education by financial obstacles such as tuition fees (OECD Education at a Glance, 2017).

Table 3.3 shows the expenditures on R&D in more detail for 2014. This year was chosen so that the data on R&D can be compared to the data on education in the prior tables. The expenditures on R&D are differentiated by the source of funds: government sector, business enterprises sector or other sources (e.g. private non-profit sector, higher education sector).

<table>
<thead>
<tr>
<th>Country</th>
<th>Total (Mio USD)</th>
<th>Governmental (Mio USD)</th>
<th>Business enterprises (Mio USD)</th>
<th>Other (Mio USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>12797.212</td>
<td>4 582.213</td>
<td>6 135.823</td>
<td>2069.176</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>6 699.446</td>
<td>2 206.882</td>
<td>2 406.875</td>
<td>2085.689</td>
</tr>
<tr>
<td>Estonia</td>
<td>544.204</td>
<td>260.22</td>
<td>201.697</td>
<td>73.287</td>
</tr>
<tr>
<td>Finland</td>
<td>7 178.164</td>
<td>1 973.855</td>
<td>3 842.331</td>
<td>136.1978</td>
</tr>
<tr>
<td>France</td>
<td>60 585.65</td>
<td>20 810.222</td>
<td>33 021.088</td>
<td>6 754.34</td>
</tr>
<tr>
<td>Germany</td>
<td>109 562.683</td>
<td>31 450.825</td>
<td>72 293.083</td>
<td>5818.775</td>
</tr>
<tr>
<td>Hungary</td>
<td>3 408.354</td>
<td>1 141.317</td>
<td>1 645.65</td>
<td>621.387</td>
</tr>
<tr>
<td>Italy</td>
<td>29 448.338</td>
<td>11 695.122</td>
<td>13 923.119</td>
<td>3 830.097</td>
</tr>
<tr>
<td>Japan</td>
<td>169 554.149</td>
<td>27 154.965</td>
<td>131 005.056</td>
<td>11 394.128</td>
</tr>
<tr>
<td>Latvia</td>
<td>327.196</td>
<td>83.809</td>
<td>91.044</td>
<td>152.343</td>
</tr>
<tr>
<td>Netherlands</td>
<td>16 404.414</td>
<td>5 442.794</td>
<td>8 380.877</td>
<td>2 580.743</td>
</tr>
<tr>
<td>Poland</td>
<td>9 149.349</td>
<td>4 136.736</td>
<td>3 567.908</td>
<td>1 444.705</td>
</tr>
<tr>
<td>Portugal</td>
<td>3 856.228</td>
<td>1 817.73</td>
<td>1 611.925</td>
<td>426.573</td>
</tr>
<tr>
<td>Slovenia</td>
<td>1 505.708</td>
<td>328.006</td>
<td>1 029.752</td>
<td>147.95</td>
</tr>
<tr>
<td>Spain</td>
<td>19 356.217</td>
<td>8 005.194</td>
<td>8 982.773</td>
<td>2 368.25</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>43 811.131</td>
<td>12 426.345</td>
<td>21 048.803</td>
<td>20 335.983</td>
</tr>
<tr>
<td>United States</td>
<td>476 460.000</td>
<td>123 611.000</td>
<td>295 422.000</td>
<td>57 427.000</td>
</tr>
</tbody>
</table>

Table 3.3: Gross domestic expenditure on R&D by source of funds, in Millions USD in 2014; Source: OECD Statistics
4 Cost-benefit analysis in the case of publicly financed universities

Knowledge has always been the basis for innovation and for the development of the society as a whole. From their origin, universities have been places of both knowledge preservation, by educating students, and of knowledge creation, by conducting research in many fields. Contributing to social development and providing solutions to current social or industrial problems has become another core role of universities. Universities do so by actively interacting with industries and society, for example via events, seminars or by establishing networks that link companies and researchers. In the literature, this branch of activities is called the third mission, which goes beyond the pure knowledge creation and teaching role of a university (Kapetaniou and Lee, 2016). Historically, heavily endowed with assets, universities maintained material independence up to the eve of the Second World War. Since then, almost all European universities, with varying degree, had to rely on governmental funds to cover expenditures (Gerbod, 1980). The positive effects of research institutions such as increased technological innovativeness and scientific discoveries at the knowledge frontier, are already a great motivator for the European Union to increase funds supporting such institutions. From a €30 million fund between 1987–1991, the Horizon 2020 Programme grants about €2.5 billion between 2014–2020 (De Bo, 2016).

In the light of the financial dependence of (most) universities and given the importance of knowledge and education for economic and social development, it is only reasonable to think about whether the public funding of universities is worthwhile from an economic viewpoint. In order to do so, the tool of cost-benefit analysis, which has been elaborated generally in an earlier section of this thesis, shall be employed. On the basis of this concept, the question of the social value of universities, their research and teaching efforts in particular, shall be examined. While the literature distinguishes between three core roles of universities, here the third mission is assumed to be rooted in either the academic research or in the teaching efforts. Solutions and improvements to social problems are thought of as an application of the research output and/or the by-product of graduates’ higher level of education. Thus from here on, the benefits of universities will be assigned to either the academic research or to the teaching activities.

Firstly and most importantly for the purpose of this thesis, the possible costs and benefits according to a clean cost-benefit analysis must be identified. This is not so much about the possibilities of a practical quantification but merely about what one ought to know in order to successfully conduct a cost-benefit analysis of any university. A general theoretical guideline, so to say. Similar attempts have been made in the case of research institutions (see Florio et al. 2016, 2016a), where some support will be drawn from. While research institutions are similar yet not quite the same as universities (conveyors of knowledge), the insights on an institution’s
level can be used on a larger scale for universities.
Given the earlier presented definition of benefits and the underlying assumptions of cost-benefit analysis (full employment and scarce resources), the benefits from universities arise from their academic research efforts and the provided academic teaching. In both cases – and in fact generally under cost-benefit analysis – households and firms are the main groups of beneficiaries (Tresch, 2008). Since the discussion of possible costs and benefits at the level of a university as a whole is rather complex and abstract because of the many social implications and externalities, a more narrow focus shall be employed in the following analysis. To make the problem at hand more manageable, the establishment of a new research facility/unit at some university is being considered. It is in fact a rather common approach in recent literature to narrow the focus down to a single research infrastructure or unit within the body of a university, in order to apply a sound cost-benefit analysis (see Florio et al. (2016), (2016a), Del Bo (2016)). This allows for a clearer description of the impacts of research institutions on economic variables.

This section is structured as follows: the two main sources of costs and benefits, academic research and academic teaching, are being discussed separately. This is a standard distinction in the recent literature. Beginning with academic research, the associated costs and possible benefits are being identified. In contrast to other studies, the different research disciplines and their impact on the possible benefits is looked at in detail, especially with regard to the varying applicability of the research output. This shall allow for a more nuanced view of the benefits of academic research, which goes beyond that of other studies. Finally, the costs and benefits of academic teaching are being discussed.

4.1 Academic research

4.1.1 Costs of academic research

As mentioned above, the case of a newly established research unit at a university is being considered. Of course, research units differ greatly among disciplines and fields of study, e.g. by the used research methods, the types of collaborations and partners. However, there are certain characteristics which apply to all such units, following Del Bo (2016): a research institution typically consists of a professor or senior researcher as the head, some junior researchers (post-doc or PhD students) and of course the necessary infrastructure (computers, laboratory, equipment, etc.). In general, research institutions are set up for a long life span and require a significant initial investment (mainly because of the infrastructure). Thus the largest part of the costs occurs upfront. In the subsequent years, research institutions often face high operational, staff and maintenance costs. Additionally, there could be negative externalities (e.g. noise, pollution) which need to be registered as costs as well. Florio et al. (2016) point out that it becomes more difficult to assign the costs to a research unit if it is part of a large institution such as a university. Thus the authors suggest to duly apportion the costs in such a case. Generally, all of those types of costs are straightforward, arise with certainty and thus are much easier to quantify than the benefits of a research unit.
4.1.2 Benefits of academic research

We continue to think of a single research unit and now turn to the benefits it induces. In return to the costs, research units create knowledge which might be used by companies or other researchers for innovations or product improvements. When analyzing the possible benefits of research units it is useful to distinguish between the various academic disciplines in terms of the practical applicability of their research output. This shall shed more light on the complex task of evaluating research. In the following, an attempt is made to identify the various benefits given the differences between the research disciplines.

Ranking of disciplines

In the vast field of academic disciplines, probably even more different research objectives and methods exist. Each discipline covers a large research field with a varying degree of practical application, which also differs for the same discipline across universities. Thus it is rather difficult to find, let alone apply, a uniform cost-benefit analysis. While the overall framework may be identical, a more nuanced approach shall be applied here: we think of the main academic disciplines as being characterized by the probability that their research output (i.e. new knowledge) leads – at least in principle – to new products or is applied in some firms.

In Figure 4.1 the most common academic disciplines are being divided into five groups, A to E, with decreasing probability that the research output has a practical use. Practical use is defined here as contributing to the development of new products or production processes of companies. The ranking of disciplines follows the criterion of whether firms may profit through new products or production processes. Note that biology and mathematics are assigned to two groups, which indicates that they include pure scientific as well as more applied research areas. Also mind that this grouping is intuitive, based on the general research agenda of each discipline, and does not claim to be exhaustive.

Group A consists of disciplines which are highly linked to a distinct application, sometimes even a specific product, having a high probability rate close to 1. Group B is relevant for products or processes in a broader sense. Somewhere in the middle, group C consists of disciplines that examine companies as a whole (e.g. structure, knowledge flows, etc.). A larger context is aimed at in group D, where markets and social or governmental frameworks are being analyzed. And
finally, there are those disciplines which seem to have no relation to a specific (tangible) product and hence a probability close to 0. Those disciplines rather try to contribute to the knowledge pool for the sake of knowledge itself. This is just an overview, a more detailed discussion of the different groups is provided later in this section. Given such a distribution of the various disciplines above, one may use the type of research within one discipline as second characteristic. Again the key feature for the distinction is the applicability of the produced knowledge, as defined by the OECD Frascati Manual (2002):

1. **Basic research** is “experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.”

2. **Applied Research** is “original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective.”

This distinction is vital for a cost-benefit analysis: both types of research generate very different benefits, which are not equally measurable. Furthermore, the shares of basic and applied research depend on the individual discipline and there is no unanimous trend among universities. Concluding from already existing studies in this context, generally both types of research are important for innovation and remain at the core of universities’ activities (Bentley et al., 2015).

Now it is time to look at the discussed characteristics (basic/applied research and product-related/product-unrelated) combined. For each subsequent pair there are distinct implications for a cost-benefit analysis and, in particular, for the quantification of research benefits.

**Applied research of product/process-related disciplines (Groups A-B)**

Disciplines with a probability close to 1 in Figure 4.1 may exert research with a strong focus on a specific practical use. In principle, firms recognize the possible profit potentials created by this research and are willing to finance it. Eventually, households should be the ones to profit from academic research. This can happen for example through a higher product quality or a lower price of goods, or if a completely new product is invented. Firms may protect a new product or production process by a patent, which creates a temporary monopoly position. New profit opportunities arise from the expected consumer rents for those new products. Similarly, a new production technology could lower the costs which allows to attract new consumers with a lower price than the competition. Again, the firm may exert a monopolistic behavior and extract the consumer rents. If the profits are larger than the costs of the research project, the firm will be willing to finance it. This case is commonly referred to as third-party funded research. Especially companies in vicinity of universities show great interest in academic spin-offs or joint research projects (Leton et al., 2014). In principle, whenever firms are willing to fund the research relevant for their business, for example in a collaboration with a research unit at a university, the government need not interfere. Governmental funding may be appropriate only if there are external effects.
The cost-benefit analysis becomes more similar to a private investment analysis, where the potential profit increase (discounted over some periods and weighted by their likelihood of occurring) is compared with the costs to give the present discounted value of the product (Brunner, 2018). Both revenues and costs are related to the product only. So all other external benefits or costs that occur to the society at large through a brand-new technology or product (e.g., smartphones), are excluded in this approach. Such external effects could be a faster-paced (work) day due to the digitalization and technological advances.

Note that the mentioned potential profits also imply that some households are willing to pay for this new product and hence for the research behind the development. This could be an indirect way to gather information about the monetary value of research for households (i.e., the willingness to pay). Also Florio et al. (2016) suggest in their cost-benefit framework to use the incremental profits of a new product, as compared to the counterfactual scenario, as a possible means of measurement. This approach is of course better suited for product/process-related research, with a high probability of application, than for research fields in groups D-E (see Figure 4.1).

**Basic research of product/process-related disciplines (Groups A-B)**

As for basic research, this is per its definition not directly linked to a practical application. This implies that there is much uncertainty about the future potential use and hence about the benefit of this type of research for both companies and households. This uncertainty translates into little profit potentials for a single company and furthermore into an unwillingness of those companies to pay for basic research. However, even if one firm dismisses a particular basic research field, there might be a great potential for other companies to profit from the results. From this argument stems the necessity of governmental financing and the collective good characteristic of basic research. Even if the benefits of today’s basic research and its insights are not foreseeable, the results are at free disposal so that some companies may profit from them at a future point in time. The calculus under cost-benefit analysis is similar as in the case of applied research above, but much more vague because of the difficulty to estimate the benefits.

**Structural level disciplines (Groups C-D)**

As we move further left along the spectrum, the benefits become more intangible and their quantification still more difficult. The disciplines in this area are somewhat linked to a practical use but rather in an abstract way or concerning companies and markets. Research is directed towards the analysis, organization, and improvement of markets, social processes, or the society as a whole. The created insights differ greatly from the ones in groups A-B by their focus and their implication for society or markets. Economics is a good example for this group. Overall, basic research dominates this discipline, aiming to generate new knowledge and insights into economies, firms, and markets. An actual application of research can be found in financial economics, which provides the foundation for economic policy decisions, governmental regulations, and for financial analyses of markets or companies. However, many other fields of economic research (e.g., behavioral economics, education economics, economic history, gender economics) tend to be hardly applicable for a direct use of a firm or a household, especially to distinct
products, and seem to be similar to humanities. A better market analysis may lead to an early detection of market failure and better laws, which in turn reduces the dead weight loss for the society because of the failure. However, those kinds of benefits are difficult to assign to one particular project or research unit. In both cases, basic or applied economic research, it is hard to tell how much households – being the ultimate beneficiaries – are willing to pay for it. Nor are there obvious profit potentials for firms. Hence the benefits of these economic research fields – similarly to the other disciplines in groups C-D – are again very difficult to quantify.

Pure knowledge disciplines (Group E)

Finally, there is the fraction of disciplines with very little to no straightforward link to any practical use. In contrast to the groups A-D, where the benefits are more or less obvious, they are rather vague and intangible for group E. The actual application of the research output is rare. Disciplines in this group are for example humanities and cultural studies but also special fields of biology or mathematics. While insights in psychology may enhance the chances of a cure (applied research), new findings in history or art are of doubtful practical use (basic research), and both create non-quantifiable benefits. The necessity and a willingness to pay (if existent) to finance these research fields is perhaps rooted in the general demand for promoting culture. Though this assumption does not facilitate the actual quantification of the benefits. Instead one could argue that the research in those pure knowledge disciplines creates some positive indirect or side-effects which justify the governmental funding of the research.

Perhaps it is appropriate to treat academic research in those disciplines as complex goods, which are unfamiliar and not directly experienced. Those goods create value for households not through their use but rather by their mere existence and preservation (Hutchinson et al., 1995), more specifically by their potential to discover new knowledge (Florio et al., 2016). People might never use the gained knowledge in history or anthropology, for example, yet they may still be interested in the background of men and hence there exists a willingness to pay for that. This non-use value is akin to those of environmental protections or culture and has to be considered in a proper cost-benefit analysis (Florio et al., 2016). According to the literature, the only reasonable method to estimate non-use values is the contingent valuation method (CVM), despite its limitations of acquiring information (Hutchinson et al., 1995). The question remains, however, how can individuals develop a willingness to pay for something they do not know of let alone understand.

For disciplines in group E, the cost-benefit analysis seems incapable of quantitatively determine the benefits. Therefore, some authors suggest a conservative approach by setting the value of those non-use benefits to zero, especially if there is a high uncertainty about them (Florio et al., 2016). If research results are applicable and there are measurable incremental profits, it is still unclear how much of those potential profits – if at all – is eventually passed along to households. The exact amount probably depends on the market situation regarding competition and distortions. It is interesting to notice that the most research institutions can be found in science fields concerning material sciences (engineering), chemistry and nano-technologies; environment, marine and earth sciences; as well as physics and astronomy (see Del Bo (2016),
pp. 27). This supports the notion above that the research outcome in some disciplines (groups A-B) seems more promising regarding future profits than the research outcome of other disciplines. Still some uncertainty about the research output’s actual usefulness remains and even if the narrowed focus on a research unit facilitates the analysis, the application of the cost-benefit framework remains difficult. Although the literature claims a quantitative evaluation of the benefits to be almost impossible and the scale of the project “university” too complex, some authors contradict and try to apply a cost-benefit analysis nevertheless (Florio et al., (2016a), Florio et al. (2016)). Some authors even recommend the cost-benefit analysis as the best suited tool to evaluate the rentability of a particular research institution.

4.2 Academic teaching

Since the founding of the first university in 1088 (in Bologna), education has been a core task and also helped to fuel the expansion of universities in many countries after World War II. Higher education was a key for economic and social prosperity and many theories (e.g. human capital theory) still support this approach (Valero and Reenen, 2016). In the case of a research facility at a university, benefits also arise due to the teaching efforts. As mentioned before, this is a key characteristic of universities, which distinguishes them from other research institutions. The benefits from higher education provided by universities need to be distinguished depending on whether they occur for an individual/graduate or at the level of the whole society. In the former case, a possible benefit of academic teaching is the higher income earned by graduates. Closely linked to the income effect is the positive impact of academic education on the employment opportunities of graduates, which is often advertised as a key incentive for young people to go to universities. Education and the various experiences made as a student affect one’s human capital, which will be reflected in higher income and a higher employment probability (Florio et al., 2016). If a positive correlation between academic teaching and employment rates of graduates can be ascertained, it is valid to consider this as a true benefit in accordance to cost-benefit analysis. Note that the general assumption of full-employment under cost-benefit analysis refers to the scientific and the administrative staff of a university. Since they are essential to establish and maintain the institution, they are considered resources. As such, they come with opportunity costs of their alternative use in another (public or private) project where they would be equally productive. As mentioned in Section 2, the full-employment assumption is a means to evaluate these opportunity costs.

Cost-benefit analysis looks at the expected higher life-time income whilst taking into account the probability that graduates could be unemployed for some time. Thus both benefits of academic teaching, increased income and employment rate, are expressed by the discounted life-time income which is higher for graduates than for non-graduates. Several existing studies provide empirical evidence for this effect of education (see Damon and Glewwe 2011, Li et al. 2011, Frenette 2008), which implies that there would be no such increase in life-time income in the counterfactual scenario without academic teaching.
This increased income leads further to higher tax revenues for the state, compared to the case of lower educated and hence less-earning individuals (Damon and Glewwe, 2011). Damon and Glewwe (2011) argue additionally that governmental subsidies for academic education are vital in order to keep enrollment at universities high by lowering the cost of studying for students. This could happen indirectly through financial support of universities so that there is no need for tuition fees. Thus eventually, the subsidies lead to more students and furthermore to increased tax revenues, which redistribute the benefits of higher education to the society as a whole. The additional tax revenues from graduates’ higher incomes could be used for governmental services or projects that benefit the general public. Therefore, individuals who didn’t go to university could have a willingness to pay for their existence and the supply of academic teaching. Damon and Glewwe (2011) admit that naturally some of the taxpayers are former graduates, which then reap both the income-benefit and the public-benefit of education. Thus there is only a partial redistribution of the benefits through taxes.

Aside from this major, monetary benefit there are a few other, non-pecuniary ones to consider. For one thing, higher education can have a positive influence on a person’s health status, as shown by Valero and Reenen (2016), and on one’s general perceived well-being/quality of life (Damon and Glewwe, 2011). One possible explanation for this is a more sensitive awareness of one’s health due to education or – and not less likely – a graduate simply can afford better medication and medical treatment. Either way, however, the health benefits from higher education, i.e. from academic teaching, are valid benefits under a cost-benefit analysis.

Then there is the claim that higher education fosters one’s individual personality, shaping and enriching it. This in turn also affects the society as a whole, if for example graduates tend to show increased civic participation or less criminal behavior (Damon and Glewwe, 2011). Unfortunately, it is somewhat doubtful whether these personal traits are achieved only or to a large extent through academic education. Thus this effects on personality can not be seen as solid benefits of academic teaching.

In contrast however, it can very well be argued that companies benefit from higher educated workers’ increased productivity, which triggers more innovations or product improvements. Several papers support the crucial role of graduates in the innovation-process of companies – especially for disciplines closely related to practical use (e.g. engineering, natural sciences) (Leten et al., 2011). While individuals are rewarded for their increased productivity with higher wages, the employing company benefits from greater profit potentials resulting from the enhanced productivity (Damon and Glewwe, 2011).

### 4.3 Conclusion

From the discussion so far it can be concluded that research of any kind provides a true challenge for cost-benefit analysis because of its vague and almost intangible benefits. Especially the non-use benefits of research are difficult to evaluate. While companies could draw on the provided knowledge pool of academic research, engage in collaborations or spin-offs with universities, where the impact on innovation/productivity can be monetized, households are affected
more indirectly. If academic research leads to significantly better products, which are also preferred by households because of the improvements (e.g. medicines), then there should exist some individuals’ willingness to pay. Quantification thereof, however, isn’t easy and even less so when the benefits stem from research without focus on application. A household’s interest in broadening the knowledge base, in fields that are far from any practical use yet alone understandable seems rather elusive but not unlikely. Their quantification is nearly impossible under cost-benefit analysis, according to Florio et al. (2016). As for applied research, even if potential profits for companies are acknowledged as indicator of households’ willingness to pay, it remains difficult to find accurate numbers.

<table>
<thead>
<tr>
<th>Probability that research output is used for new products/production processes</th>
<th>Benefits of academic research</th>
</tr>
</thead>
</table>
| 1 | Product/process-related disciplines (groups A-B)
  - e.g. Computer Sciences, Engineering
  - Medicine, Pharmacy, Chemistry
  - Physics, Corporate Finance, Marketing, Logistics, Mathematics (partly)  
  - Improved products, more efficient production processes
  - Innovations and new technologies
  - Temporary monopoly position and additional profits for firms |
| 1 | Structural level disciplines (groups C-D)
  - e.g. Economics, Public Finance, Law, Sociology, Organizational Studies Management, Innovation Studies  
  - Analysis, organization and improvement of markets, laws and social processes
  - Detection of (market) failure
  - Improvement of the legal framework for economic activities |
| 1 | Pure knowledge disciplines (group E)
  - e.g. Philosophy, History, Languages, Gender Studies, Cultural Studies, Mathematics (partly), Astrophysics, Biology (partly)  
  - Creation of knowledge per se
  - Cultural aspect
  - Indirect and intangible side-effects |

Figure 4.2: Summarizing overview of the benefits of the ranked disciplines

Also the benefits from academic teaching have a vague and non-pecuniary component which makes them rather elusive. Thus the discussion falls into the domain of public decision making, where lobbying plays a role and collisions of interest further complicate the issue (see Public Choice Theory). An overview of the benefits discussed in this section is given in Figure 4.2. Considering the benefits of universities in the context of cost-benefit analysis – even with a narrowed focus of a single research unit – is tiresome and unsatisfactory. It is little surprisingly then that the few existing studies regarding this topic adopt a different approach to quantify the benefits. The chosen studies and their specific methods in comparison to cost-benefit analysis, as well as remarks on the argumentation, are discussed in the following.
5 Analysis of existing studies

Despite the difficulties of quantifying the benefits of universities, some recent studies take on the challenge and try to provide helpful insights for political decision making. The literature regarding this topic is large and shall be reviewed briefly for a better understanding of the context. The recent studies can be categorized by their research focus and agenda, which differs a lot across authors despite the similar overall topic. As mentioned earlier in this thesis, the activities of a university can be split into three core tasks: teaching, research and the so called third mission, meaning contributions to social development and problems. This differentiation can also be found in the literature, where some authors focus on the returns/benefits of academic teaching (Dickson and Harmon (2011), Li et al. (2011), Devereux and Fan (2011), Damon and Glewwe (2011), Frenette (2008)), on the benefits of academic research (Schibany and Gassler (2010), Bo (2016), Leten et al. (2011)) or solely on the third mission of universities (Kapetanion and Lee (2016)).

Other authors like Florio et al. (2016), Florio et al. (2016a) as well as Janger et al. (2017), take a look at all the benefits stemming from the research and teaching efforts of universities or research facilities. But they do so at different levels of generality. Florio et al. (2016a) show how the framework of a cost-benefit analysis can be applied to a particular big-scale example of a research infrastructure, the Large Hadron Collider at CERN. The general findings and lessons from two other applications of their framework are summarized in Florio et al. (2016). In contrast, Janger et al. (2017) employ a broader focus and examine the benefits and effects of universities in the case of Austria. At the national-level, they compare the costs and benefits of existing universities, albeit not wholly consistent with cost-benefit analysis (as shall be discussed later in this section).

Then there is the group of studies which are interested in the impact of universities on a specific economic variable. For example, Abhijeet (2010) investigates the relationship between government expenditures on academic education and economic growth in India. Similarly, Gamlath and Lahiri (2018) and Valero and Reenen (2016) focus on the impact of universities on economic growth. However, they used their regression model on a large international data set in order to gain general insights into the investigated relationship.

And finally, one may also categorize the studies by the beneficiary of the positive effects, i.e either the graduates, the companies or the state. Considerable interest is being shown for the relationship between universities/research institutions and companies (Szücs (2018), Sadeghnezhad et al. (2018), Cunha Lemos and Ferraz Cario (2016), Leten et al. (2014), Soh and Subramanian (2013), Dornbusch and Neuhäuser (2015), Fischer and Varga (2003)).
Some of the studies above are being analyzed in detail in this section. In particular the benefits listed in those studies will be compared with those benefits which were identified as being relevant for a sound cost-benefit analysis. This shall provide insights into recent literature and reveal whether the chosen studies are biased in some way – or at least highlight the different approaches of measuring the benefits of universities/research institutions. The choice of the studies was done as follows:

- Florio et al. (2016, 2016a) for an alternative cost-benefit framework and the application to research institutions.
- Janger et al. (2017) for their broad view on positive effects of academic teaching and research and the specific situation in Austria.
- Damon and Glewwe (2011) for an American perspective on the impact of universities.
- Valero and Reenen (2016) for a more international and macroeconomic view on the relation between the existence of universities and a country’s economic growth (GDP).

The methodology and purpose of each study will be presented first in a short description. Afterwards all the proposed benefits by the selected studies shall be discussed together. In this analysis, similar to the discussion in the beginning of Section 4, the benefits are split into those regarding academic research and academic teaching. However, the examined literature suggests also some benefits which result from both areas or which cannot be clearly assigned to research or teaching.

5.1 A short description of the selected studies

While all of the chosen studies examine the effects of universities, they do so on different levels of generality. Damon and Glewwe (2011) focus solely on public universities in Minnesota, Janger et al. (2017) examine the situation in Austria, showing benefits specifically to this country, whereas Valero and Reenen (2016) take a broader, more international view. It will be interesting to see how much their results align and if the case for Austria matches the international trend; and of course which positive effects are proposed for universities in general.

5.1.1 An alternative cost-benefit framework for research institutions
(Florio et al. (2016, 2016a))

In accordance to the prior discussion, Florio et al. (2016) admit that an evaluation of research output is difficult because of its elusive nature and its uncertain practical usefulness. But motivated by the need for an appropriate method of analysis, the authors tried to apply the framework of cost-benefit analysis to different research institutions: the Large Hadron Collider at CERN and the National Centre for Oncological Treatment (CNAO) in Italy. By doing so, the applicability of cost-benefit analysis in this context is being assessed.
The applied model is in accordance with cost-benefit analysis, where a project’s expected economic costs $E(EPV_{C_\text{u}})$ and expected economic benefits $E(EPV_{B_\text{u}}) + E(EPV_{B_\text{n}})$, (all expressed as net present values), are compared:

$$E(ENPV_{R\text{DI}}) = E(EPV_{B_\text{u}}) + E(EPV_{B_\text{n}}) - -E(EPV_{C_\text{u}}) \quad (5.1)$$

The above equation gives the expected net present value of the research infrastructure’s output ($E(ENPV_{R\text{DI}})$). Note that the benefits are split into use benefits ($B_\text{u}$), which arise from the use of the research outputs and the facility itself; and non-use benefits ($B_\text{n}$), i.e. the social value of the discovery potential of the research facility. The latter is not linked to a practical application of the gained knowledge. Also, the authors assumed all critical variables to be stochastic (hence the expectation operator) and linked to a probability distribution function. The variable’s value is set to zero if it is radically uncertain. This way, at least some of the risk associated with large (RI) projects is being accounted for. Additionally, the benefits which are not marketed are being estimated by shadow prices, hence the adjunct “economic” to all terms of the equation.

Similar to projects in general, Florio et al. (2016) identify capital costs, labor costs (i.e. salaries of scientific and administrative staff), operating costs (materials, energy,...) and negative externalities (e.g. noise, pollution) as valid costs for their analysis. Sunk costs are purposefully left out and the authors advise to duly apportion shared costs if the research facility is part of a larger institution.

As for benefits, there are several groups of beneficiaries that each profit from research institutions in several ways:

Firms may use the research output to improve their products or to generate innovations. This benefit is measured by the expected incremental shadow profits from the sale of those new products, compared to the profits in the counterfactual scenario (i.e. without the research institution). Also, research institutions and their output lead to start-ups and spin-offs (i.e new firms). Florio et al. (2016) evaluate this benefit at the expected total shadow profit over the lifetime of the start-up, compared to the counterfactual scenario. Another way for firms to benefit from research institutions are knowledge spillovers, which can also happen through patents. The authors propose several methods to evaluate this benefit: incremental shadow profit, avoided costs and willingness to pay. Finally, firms that are suppliers for the research institution may gain new knowledge and skills on a learning-by-doing basis of collaboration with the technical and scientific staff. Again this benefit can be measured by the marginal increase in profits for the supplying firm, compared to the counterfactual scenario.

Another group of beneficiaries are the scientists and students at the institution, although they are employees and thus contribute to the cost side of the research institution. Florio et al. (2016) argue that this is a special case where the employees at the same time produce the service and benefit thereof. They do so by increasing their human capital through the working experience, which can be measured by the expected incremental lifelong salary, compared with the counterfactual scenario.
Scientists may also use the knowledge they already created in order to gain new insights and trigger further innovations. The evaluation of this particular benefit isn’t that simple because the value of the research output is often wrongly mixed or confused with the value of research/-knowledge per se – which is even more difficult to quantify.

Then Florio et al. (2016) distinguish a separate group of consumers of the research institution’s services. In contrast to the previous groups, here the benefits arise from the use of the institution’s equipment or special services by external parties (e.g., industry partners, government, other research teams). For example, the research institution could sell excess computing resources, access to archives and collections or software. These services, as well as the benefits thereof, are independent from the research output of the institution and thus independent of the firms and scientists groups. As methods for quantifying this benefit, Florio et al. (2016) suggest to use the long run marginal costs of the services or to estimate the external users’ willingness to pay for the services. Of course, consumers also benefit from the research institution by making practical use of the research outputs. A common approach of measurement is to again estimate consumers’ willingness to pay for the access to the research output.

The groups listed so far all profit directly from the research institution and its output (i.e., use-benefits). Yet there are also non-use benefits and the benefits to the general public. Florio et al. (2016) underline the importance of non-use benefits in the case of basic research, where the future potential for a practical application can not be known beforehand. They further argue that cost-benefit analysis is incapable of quantifying these highly uncertain benefits and hence recommend to set their value to zero. Also the value of knowledge per se for the general public is a non-use benefit (assuming that the average taxpayer will never actually make use of the research output), yet it can be measured by the current willingness to pay of the taxpayers (e.g., by using the contingent valuation method).

When both costs and benefits have been identified, evaluated and discounted to present values, Florio et al. (2016) calculate the net present value of the project. Afterwards, a probability is assigned for each critical value of the analysis, in order to properly consider forecasting errors. The authors use a Monte Carlo simulation to approximate the probability distribution function of the critical values within the analysis. For details on this statistical tool see Robert and Casella (2004) and Balcombe and Smith (2011). By applying the CBA framework to large research projects in the fields of physics and medical science, Florio et al. (2016) aim to test the empirical use of the approach. They admit that there is still much room for fine tuning and methodological improvements in special cases and thus hope to incite other researchers to do some further application of the cost-benefit framework. Once the framework has been tested in different other research areas, Florio et al. (2016) are convinced that it will be accepted as a reasonable supporting tool for decision makers.
5.1.2 Benefits of academic teaching and research in Austria (Janger et al. (2017))

While the previously discussed study examined the application of the cost-benefit framework to projects in general, the study by Janger et al. (2017) tries to identify the economic effects of the project “universities” in Austria. Here the focus lies on all possible benefits and costs, including a description of the channels through which those benefits affect the Austrian economy as a whole. At first, an exhaustive list of those effects and channels is presented. Then the authors try to evaluate the effects, thus underlining their importance, with empirical data for Austria. Given the scope of their study, Janger et al. (2017) draw on large datasets from the OECD (the Education at a Glance (EAG) report and the REGPAT database for information on patents of specific regions), the Statistik Austria as well as data from the Austrian Federal Ministry of Education, Science and Research (BMWFW). Additionally, Janger et al. (2017) did some own calculations, which are unfortunately not publicly accessible.

A distinction is being made between effects for graduates individually and for the whole national economy; as well as between short-term and long-term effects. Each of those will be quickly discussed in the following:

**Graduates** benefit from academic teaching through an increased productivity, which results in a higher income on the labor market. Since both private companies and the government are interested in a highly-skilled workforce in order to boost innovativeness and international competitiveness, university graduates also face a high employment rate. According to Janger et al. (2017) there are also other, non-pecuniary benefits of academic teaching which are worth noticing. First, a higher level of education seems to correlate positively with one’s own health status and the perceived quality of life. And secondly, graduates are claimed to show more social and political participation.

Of course some of the benefits for graduates also affect the **whole economy and general public**. The higher income rates combined with an increased likelihood of employment lead to a rise in tax revenues. Additionally, Janger et al. (2017) claim that the better health of graduates takes off some of the pressure on the national health system by reducing the necessary governmental expenditures. While those effects are linked to the ones at the individual level, there are also benefits of universities which occur rather for the whole economy, such as: increases in innovations and more innovative companies, the solution of social problems and the enhancement of Austria’s cultural image. As mentioned above, the listed effects are also categorized as short- and long-term ones. **Short-term effects** are demand-sided and arise from universities’ spending on salaries and investments. In contrast, the supply-sided **long-term effects** increase the country’s productivity through highly-educated graduates or through research collaborations with local companies. The used method to evaluate all these benefits, as well as specific numbers, are presented in more detail later in this section.
Janger et al. (2016) conclude from their findings that universities create considerable positive economic and social effects, which outweigh the costs by far. According to their estimates, after 3-5 years the generated benefits (i.e., higher tax revenues and social insurance contributions, lower governmental spending) cover the initial as well as ongoing governmental spendings on the university. However, Janger et al. (2016) focus in their analysis on a university’s activities that create value in some way and regard the resulting effects as benefit—even if they are only indirectly linked to universities. This approach does not align with cost-benefit analysis, as shall be elaborated later on in this section.

### 5.1.3 The benefits of academic teaching in the case of Minnesota (Damon and Glewwe (2011))

After the general view on cost-benefit analysis in the case of research institutions (Florio et al. (2016)) and the focus on the current situation in Austria (Janger et al. (2017)), now an U.S perspective on the matter shall be included. For this purpose, the study by Damon and Glewwe (2011) has been chosen and will be summarized briefly in the following.

In a case study of Minnesota, Damon and Glewwe (2011) examine the private and public benefits of academic teaching. Additionally, the quantified benefits are compared to the governmental expenditures on universities in order to gain insights about the rentability of those expenses. And finally, some redistributive impacts of the benefits are being discussed. Due to a lack of data, the authors explicitly omit any benefits from academic research of Minnesota’s universities, as well as benefits to other countries (e.g., through migration of graduates). The study draws on data regarding enrollment, tuition and governmental financial support provided by the Minnesota State Colleges and Universities (MnSCU) system, the National Science Foundation, the Minnesota Office of Higher Education, the U.S. Census Bureau and the U.S Bureau of Labor Statistics. Unfortunately, the authors’ exact calculations are not publicly accessible, so one can only assume that they had to sort through this mass of information somehow to distill their key findings.

Regarding the private benefits of academic teaching, those can be split up in pecuniary and non-pecuniary ones. The first group consists of the higher income and the related higher employment rate for graduates. Non-pecuniary benefits of academic teaching are the increased health status of graduates (measured in this case by the lower mortality rate) and a better perceived quality of life.

Then, of course, the private benefits create effects for the whole state of Minnesota since graduates’ higher income lead to increased tax revenues. Through governmental transfer programs, those benefits are redistributed to individuals who did not enjoy an academic education. Again the public benefits can be divided into pecuniary and non-pecuniary ones. As for the former, higher educated employees affect the company’s performance through their own higher productivity, as well as by positively influencing the productivity of other, lower educated employees. The authors note, however, that this internal spillover effect is linked to a production function with constant returns of scale, given that the two types of employees are not perfect substitutes.
Damon and Glewwe (2011) also list a few non-pecuniary benefits of academic teaching: increased civic participation in social and political matters, reduced crime rates for graduates (which could lead to less governmental costs on the legal system) and enhanced social interactions. The monetary values of those benefits are, however, difficult to measure because of lacking data.

After a general discussion of the benefits above, Damon and Glewwe (2011) present their figures for the case of Minnesota. A few of those shall be discussed in a later section of this thesis. The largest evidence could be found for the income effect of graduates, as well as for the spillover effect on the income of other employees. However, as the authors also mention, not every benefit could be properly quantified such as non-pecuniary public benefits – and more importantly, the benefits of academic research.

Despite the limitations of their study, Damon and Glewwe (2011) regard their findings as one of the most comprehensive attempts to depict the situation of U.S. public universities. They further conclude cautiously that the total benefits from academic teaching outweigh the costs. Of course, more research and estimates are necessary to consolidate this conclusion, and Damon and Glewwe (2011) assign high priority to a solid quantification of the benefits of academic research.

5.1.4 An international assessment of the impact of universities on national economic growth (Valero and Reenen (2016))

On a more general level, Valero and Reenen (2016) examine the relationship between academic activities and national growth and present four possible ways for universities to affect the GDP. Firstly, universities contribute to the human capital of a country by generating highly skilled workers with increased productivity. Secondly, universities affect a country’s innovativeness through the researchers at the university itself (own innovations or collaborations with companies) or through the innovativeness of graduates. Thirdly, universities promote pro-growth institutions through their publications, events and democratic dialogue. And finally, universities create demand for services and goods. In particular, the students’ and staff’s consumption could positively affect the national growth.

In a second step, Valero and Reenen (2016) try to find empirical evidence for each of those channels by running their own regression model on information about universities in different countries. The main source of data is the World Higher Education Database (WHED) issued by the International Association of Universities and UNESCO. This full listing contains 16,326 universities across 185 nations. Universities which do not offer at least a 3-4 year diploma or postgraduate degree are being excluded from the database (e.g. community colleges). The authors further restricted the available data and chose only those countries with information dating back to 1955. This resulted in about 14,868 universities across 78 countries. While looking at the key variables (university location, founding date, offered disciplines and qualifications, financing) the authors also measured the density of universities by region across time (controlled for the region’s population).
Their main estimating model is expressed in growth rates and has the following form:

\[
\Delta \ln (Y/L)_{ic,t} = \alpha_1 \Delta U_{ic,t-5} + X'_{ic,t-5} + \alpha_2 \ln (Y/L)_{ic,t-5} + \alpha_4 \Delta \ln pop_{ic,t-5} + \eta_t + \tau_t + \varepsilon_{ic,t} \tag{5.2}
\]

with the GDP per capita in region \(i\) in country \(c\) and year \(t\), \((Y/L)_{ic,t}\), and the lagged number of universities within the region plus 1, \(U_{ic,t-5}\) (to include observations with no universities). Other observables which could affect GDP are controlled for in the \(X'_{ic,t-5}\) term. Since both the growth of GDP and that of universities depend on the population of a region, the authors control for this explicitly in \(\ln pop_{ic,t-5}\). Further, they include country fixed effects \(\eta_t\), time dummies \(\tau_t\), and an error term \(\varepsilon_{ic,t}\). All estimates are done for periods of 5 years (thus the lag) in order to consider that universities affect GDP not immediately. Valero and Reenen (2016) then add robustness tests and check for the relationship between GDP and the increase in the number of universities. As the tests reveal, GDP has no direct impact on the creation of new universities. However, there may be time-varying unobservables which cannot be controlled for in the model (e.g. varying local governments which enforce growth policies that also create new universities). The authors argue that such policies and their actual implementation (i.e until the university is built and running) require too much time to impact the regression results.

Returning to the proposed channels through which universities may affect growth, Valero and Reenen (2011) find a small but highly significant correlation between growth of universities and the number of college students.

Furthermore, the estimates show a positive correlation between university growth and the current patent stock, which also has a positive impact on per capita GDP. As for the third channel, the authors find highly significant evidence that universities promote the democratic system, even when individual demographic variables are being controlled for. Interestingly, there seems to be a spill-over effect from students and staff towards people without direct contact to universities, increasing the approval of democracy of the latter. Unfortunately, the authors were not able to estimate the impact of this particular channel on the national growth, yet they assume that there is one in the long-run.

Finally, the demand channel of universities is being examined and, given the many controlled variables, there seems to be no effect on growth due to the consumption from students and staff. The authors argue that the largest demand impact on GDP would happen in the founding year of the new built university, when transfers and set up costs are high. This is already captured and controlled by the lagged GDP.

In summary, Valero and Reenen (2016) provide evidence for universities affecting growth through human capital and innovation channels. In a long-run perspective, also the democracy/institution-channel becomes more significant. As for the demand-channel, there could not be found convincing evidence that universities contribute to growth that way. This also implies that the general effect of universities is not driven by demand for consumption by staff and students. Overall, the small but significant results are considered as lower-bounds of the long-term positive effects.
of universities, as mentioned by the authors. They are also convinced that further research and better university data should reveal stronger evidence for the positive relationship between universities and national growth.

5.2 Benefits of academic research

As mentioned above, some authors distinguish between public and private benefits. However, in some studies there is no explicit grouping into benefits from academic research or teaching. So here in this thesis, it is done based on the studies’ context and the explanations the authors offer for each benefit. This allows for a better overview of all the proposed benefits. Following this approach one may discover that most of the benefits of universities seem to occur through the teaching efforts. Those shall be discussed in detail in the next subsection.

5.2.1 Increased local innovativeness

As for academic research, the only reported effect is a strong increase in the local innovativeness. Janger et al. (2017) measure this benefit through various channels: Firstly, they consider university patents, which is an indirect way but nevertheless, patents are essential for product development and innovation. In 2014, 50 patent applications were filed by universities in Austria and the trend seems to go upwards. According to the authors, however, this number is massively understated because often the university is not named as the owner of the patent but the researcher(s) instead, and this distorts the data (Janger et al., 2017).

As indicated by the data, patents granted to universities tend to draw on a larger knowledge base and more on basic research, compared to patents of companies. Janger et al. (2017) show this by the average share of scientific papers among the sources of the patents, which is 37% for university patents and 9% for company patents. Hence the patents filed by universities have a considerable potential to be useful for several companies, now or in a future point in time. So universities contribute to a country’s innovativeness through patents (which are licensed for companies) or through the research publications (Janger et al., 2017). Either way supports the above mentioned notion that governments have an incentive to fund academic research that is linked to product or production processes. While patents could be seen as an academic reply to current industry issues, the publicly accessible research outputs have a collective good aspect which justifies the (financial) governmental support.

As a second and more direct measurement of the benefits of academic research, Janger et al. (2017) look at spin-offs (i.e. new founded companies based on academic research output) and at a university’s revenue from licensing technologies (which are also based on the research efforts). In 2015, 19 new spin-offs were founded but there still is little information on their value creation available. Regarding licensing technologies, the data shows that universities earn about €3.5 million from such agreements (Janger et al., 2017).
Finally, the authors examine how collaborations with universities affect the innovativeness of companies. And in fact, the data shows that more radical innovations are created among co-operating companies. In 2014, 60% of Austria’s top innovative companies were collaborating with universities and they spent on average twice as much on innovative processes compared to companies that do not collaborate with universities or other research institutions (expenditures for innovation are measured as percentage of total revenues) (Janger et al., 2017). However, this relationship is not necessarily causal because companies that cooperate with universities also tend to be bigger and, given their available resources, naturally engage more in their innovation processes. Still the authors regard universities as a driving force in the innovativeness of companies, showing that almost 90% of the companies collaborating with universities introduce new products to the market (Janger et al., 2017).

On an international scale, there seems to be a similar positive effect of universities on innovativeness. At least the patents issued by universities correlate with an increase in GDP per capita: a doubling of the patent stock results in a 5% increase in GDP. Also, the raw correlation between lagged university growth and the increase in the number of patents is positive (Valero and Reenen, 2016). The authors suggest that there are other mechanisms apart from patents through which universities contribute to the local innovativeness, e.g. through the graduates. This aspect is discussed in the subsection for academic teaching later on.

By measuring the value of academic research through patents, however, one may evaluate the more practical research fields (e.g. medicine, engineering) rather than research of less application-focused disciplines (see group D-E in Fig4.1). As mentioned before, those latter disciplines are probably not as interesting for companies to collaborate with, given the lower profit potential. Also Janger et al. (2017) admit that cooperations in technological or medical fields are more profitable.

This lack of interest could be an explanation for less patents in those disciplines. On the other hand, the very nature of the research is perhaps that it is at such a basic level or so unspecific to a product (e.g. insights in psychology) that the research output is unpatentable.

Another point worth noticing is that patents are not an ideal measurement tool since – as both Janger et al. (2017) and Valero and Reenen (2016) mention – there is a considerable gap between the number of patents developed at universities and the number of actual patent applications filed by universities. This could be because the researchers are named as owners of the patent and this makes it difficult to analyze if a patent had its roots in a university. Measuring the benefits of this type of research, if not through patents, could be done by looking at publications or by peer-reviews instead. However, these tools do not assign a monetary value, which could be compared to the benefits of product/process-related research. Hence there remains a lack of proper evaluation methods for the benefits of product/process-unrelated disciplines.
5.2.2 Solutions to social problems

In the beginning of their paper, Janger et al. (2017) list the problem solving capacity of academic research as one of its benefits to society. Through publicly accessible papers (and patents to some extent) the findings may help to solve current social problems like for example environmental problems. This is seen as a core mission of universities, apart from teaching and the production of research itself (Janger et al., 2017). However, the authors do not provide any numbers supporting this claim, nor do they suggest a potential measurement tool. Similarly, Florio et al. (2016) argue that the future value of research is impossible to evaluate. This underlines the complexity of the task and the earlier notion that research output with little to no practical application are the most difficult to quantify. This refers to the disciplines in groups C-D in the previously discussed ranking of disciplines.

5.3 Benefits of academic teaching

A large share of the benefits listed in the underlying studies stem from the teaching provided by universities. This is perhaps due to the earlier discussed difficulty to evaluate academic research, especially of product/process-unrelated disciplines where the research output is not – or indirectly – monetized. Regardless the availability of the data, perhaps academic teaching enjoys such attention because of the view that it is fundamental for a country’s growth and international competitiveness (Li et al. (2011)). The following section shall explore the claimed benefits of academic teaching, first those occurring to the graduates themselves and then those occurring to the society as a whole.

5.3.1 Human capital and higher productivity

The most obvious benefit for graduates seems to be the positive impact of higher education on the income in the labor market. Both studies draw on the human capital theory to explain this relationship: every effort to obtain education is perceived as an investment which will pay off eventually through higher income after the education is finished. According to Janger et al. (2017), a Master or Doctorate degree results on average in a 79 % increase in gross income, compared to a high-school diploma (Matura in Austria). Also for the U.S., an additional year of higher education leads to a 7-9 % increase in income (Damon and Glewwe, 2011). Through education, especially at universities, students may increase their productivity and innovativeness, which not only makes them attractive to companies but which also justifies a higher income (Janger et al., 2017). The innovativeness of graduates is another channel through which universities, apart from their own efforts (i.e. publications, patents), enhance the local innovative processes (Valero and Reenen, 2016). Thus, concerning innovations, there is a link between academic education and research since graduates, as they become employees in firms, may be the ones to apply a university’s licensed patents or publicly accessible research output. And academic education as a key enables them to do so.

Given the available data, Janger et al. (2017) compare the private costs of tertiary education with the monetary benefits for graduates. Total private costs are the direct costs of studying (tuition fees and costs for studying supplies) and the forgone earnings during the period of
studying. Total private benefits is the gross income plus unemployment insurance payments, minus taxes and social contributions (all over a career of 40 years). Both costs and benefits are discounted to present values with a discount rate of 2% (OECD average real interest on government bonds). Subtracting total costs from total benefits, both in present values, gives the net present revenue of tertiary education: 266,200 USD for men and 146,500 for women. Further, the internal return rate, at which costs and benefits would break even, is 11% for men and 8% for women. The OECD average lies at 13% and 11% respectively (Janger et al., 2017).

From the viewpoint of cost-benefit analysis it is justified to consider this income increase as a benefit if the increase in individual productivity is due to the received education and would not happen without it. There already exists some empirical evidence that graduates of academic institutions eventually receive higher income in comparison to graduates of the secondary educational level (see Janger et al. (2017), Damon and Glewwe, (2011)). In general, there is little doubt about this, but it is worth noticing that some skills might be achieved independently from education. Even Janger et al. (2017) mention that in this case, a diploma might serve as official approval or signal of the already existent skills.

Also the calculated internal rate of return of tertiary education, as done by Janger et al. (2017), aligns with the principles of cost-benefit analysis. From examining their study, one can conclude that the authors considered the costs of studying, opportunity costs (i.e. forgone income) and income benefits adjusted for taxes in their analysis.

Closely linked to the income-benefit is the increased likelihood of employment for academics. Janger et al. (2017) argue that in our modern world, companies rely more and more on highly educated workers and thus create a considerable demand for academics. But also governments are interested in a highly skilled workforce in order to strengthen the country’s position in the international competition. Innovations at the technological frontier are key to success and the increased complexity of the tasks and technologies requires a certain level of education (Janger et al., 2017). The authors report that the unemployment rate for academics in Austria remained steady at 4% since 2013, while the country’s overall unemployment rate rose to 6.1% (Janger et al., 2017). For comparison, the European average lies at 9% (OECD, 2017). This is of course most plausible for disciplines closely related to practical use like engineering, medicine, computer sciences etc. (see Figure 4.1). According to the estimates, this trend of a constantly low unemployment rate for academics will continue at least up to 2020 (Janger et al., 2017).

Another important trigger for the higher employment rate (or lower unemployment rate) of graduates is the fact that academic education seems to have a long half-life period, enabling an aging society to be productive and part of the workforce for a prolonged period of time. In Austria, about one in two academics with an age of 55-64 years is employed full-time (Janger et al., 2017).

From the viewpoint of cost-benefit analysis, the higher employment rate eventually leads to an increased lifetime income (as compared to a counterfactual scenario without tertiary education) and counts as a valid benefit of academic teaching. At this point, one may remember the full-employment assumption of the cost-benefit framework and wonder why it is not applied to
the employment of graduates. However, this assumption is used to evaluate the opportunity costs of the needed resources for universities. Both the scientific and the administrative staff of a university are essential to establish and maintain the institution, and thus thought of as resources. As mentioned at the beginning of this thesis, the full-employment assumption combined with the scarcity of resources implies that there is always a need for workforce either in the private or the public sector and that their salaries are opportunity costs of the forgone use elsewhere (Tresch, 2008). By assuming that the academic staff could be equally productive in another “project” or private company and treating their salaries as costs in the calculation of the net-present value, the result will show the pure benefits of the university itself.

As for graduates, they are not employed by the university and thus not considered as resources to which the full-employment assumption is applied. Through tertiary education graduates can increase their productivity, which is reflected by higher wages and better employment prospects, as compared to the counterfactual scenario. Thus it is valid to add those two aspects to the benefits-side of academic teaching.

### 5.3.2 Health and social participation

Aside from monetary benefits, academic education is claimed to affect also other aspects of one’s life. A higher level of education seems to improve one’s perceived health status, which translates into higher life-expectancy for academics. This could be because of a more sensitive awareness for the own health (Janger et al., 2017) or simply because graduates can afford more (and perhaps better) medical treatment. In the latter case, the health effect would be closely related to the income effect of academic teaching. Although the correlation between academic education and health, adjusted for income, has been investigated (see Damon and Glewwe, 2011), there is no substantial proof for it. The health effect can not be assigned solely to either higher education or higher income. Therefore and for simplicity, the effect of universities on health and income are being treated independently in this thesis.

Both Janger et al. (2017) and Damon and Glewwe (2011) mention that an increased health status could result in an overall better quality of life. They refrain, however, from providing any empirical evidence for that.

It is worth noticing that through the health-channel, academic teaching also benefits the society as a whole. A healthier population may be more productive and does not put that much strain on the governmental health system (Janger et al., 2017).

Apart from health, academic teaching may also foster other positive aspects of social life, which is both a benefit for the individual and for the society as a whole. More active social and political participation, less criminal behavior and a pro-democratic attitude are listed as the main positive effects (see Janger et al. (2017), Valero and Reenen (2016), Damon and Glewwe (2011)). In particular, Valero and Reenen (2016) show a significant correlation between the existence of a university and the acceptance of democracy in that very region. The authors tentatively suggest further that this is related to the academic teaching and the resulting mindset of graduates (Valero and Reenen, 2016).
Considering cost-benefit analysis, the effects on both individual and societal level are again justified if they would not occur in the absence of universities. While this is difficult to prove, the findings of existing studies distinctly suggest that universities at least contribute largely to those developments and attitudes. Also the tentative comparison with lower level education, as done by Janger et al. (2017), hints at the major role of universities in this context and tries to justify governmental funding.

In summary, it is justified to count the impact on health and social aspects of graduates (and thus of the society) among the benefits of universities. Unfortunately, the quantification of this benefit remains unclear and rather difficult. Although Janger et al. (2017) and Damon and Glewwe (2011) present empirical numbers that estimate the impact of academic teaching on health, they do not translate these into a pecuniary evaluation of the benefit. Thus this remains a task for future research and skilled cost-benefit analysts.

### 5.3.3 Public returns from academic teaching

Also the state benefits from academic teaching since the above mentioned private benefits eventually result in effects on the system-level. This happens either through taxes or through a reduction in state spending. The studies under scrutiny list the following benefits of academic teaching for the society as a whole (see Janger et al. (2017), Valero and Reenen, (2016)):

- tax revenues from graduates’ higher income
- tax revenues from consumption expenditures of foreign students
- less governmental spending on the health system and on unemployment

As discussed earlier on, academic teaching leads to a higher income for graduates and conclusively this results in the following tax revenues: 182,100 USD income tax from male graduates across their occupational life and 100,100 USD from females (not adjusted for the costs). By comparing these revenues with the forgone income tax during the years of studying (11,200 USD for males, 11,300 USD for females), the pure net income tax effect is 170,900 USD and 88,800 USD respectively. Adding social insurance contributions, subtracting the public direct costs of studying (funds and subsidies for education), and after discounting, male graduates generate a net revenue for the state during their job-life of 180,400 USD and females 91,700 USD. The public return rate on academic teaching in Austria is therefore 7 % for men and 5 % for women (values for 2010; Janger et al., 2017). For comparison, a short overview of the return rates for men and women from other countries is presented in Table 5.1.

Given that graduates achieve a higher level of productivity through tertiary education and that this productivity is reflected by the gross wages accordingly, the resulting tax revenues and social insurance contributions from graduates are also higher, as compared to the counterfactual scenario. In the absence of universities (i.e. academic teaching) the tax income from those individuals, who would have graduated, is decreased. Therefore, they are directly linked to the existence of universities and thus a valid benefit according to the cost-benefit framework.
As already mentioned, to prove the actual correlation between tertiary education and higher wages (and eventually higher taxes) one would have to compare the earnings of graduates with their earnings if they had not attained the tertiary level of education. This counterfactual effect is required yet very difficult to show since an individual cannot graduate and not-graduate at the same time. One way to avoid this dilemma is to look at a young or newly founded university, and compare the salaries of graduates with the salaries of the previous generation, which didn’t have access to tertiary education. While this approach is not flawless, it seems more reasonable than to compare the wages of individuals with different levels of education at the same point in time, as it is done by Janger et al. (2017). The authors mention, however, that it is not clear whether the rise in productivity, causing the wage difference, can be attributed solely to academic teaching.

A second impact on taxes is claimed to stem from the additional consumption of foreign students in the vicinity of universities. Through their expenses for housing, living and other products and services, they contribute not only to the regional growth (Valero and Reenen, 2016) but of course also generate tax revenues of €570 million (Janger et al., 2017).

According to Janger et al. (2017), the consumption of foreign students also creates additional jobs within the region and furthermore additional social insurance contributions of €715 million. However, under cost-benefit analysis it is not so clear whether this can be seen as an actual benefit. Because these consumption expenditures seem to be more secondary benefits, meaning that they would also occur under another similarly large governmental project. Their value is but a multiplier of the primary project benefits. Generally, such secondary benefits are not considered as net benefits to society because they are not related to a specific project (Tresch, 2008). In the case of foreign students it is doubtful whether their consumption creates more value than any other governmental spending or project. What if there would be, for example,

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<th>COUNTRY</th>
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<td>10</td>
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<td>Switzerland</td>
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<td>United States</td>
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<td>OECD average</td>
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Table 5.1: Public rate of return of tertiary education for men and women in 2013 (OECD, Education At A Glance 2017)
a museum or additional apartments instead of the university? In both of these scenarios people would be drawn there, probably also from outside the region, and their consumption expenditures could very well be just equal to those of foreign students (and hence result in equal tax revenues). Following this line of thought as well as the advice given by Tresch (2008), it seems reasonable not to ascribe too much value to this tax effect and instead focus on the unambiguous benefits of academic teaching.

A more plausible benefit of academic teaching arises from the apparently healthier graduates, which eases the burden on the national health system (Janger et al., 2017). While Janger et al. (2017) provide numbers for the perceived health status, they do not state estimates of the resulting financial benefit for the health system. They just mention that this is the case. On the other hand, however, the fact that graduates face a higher life-expectancy could also imply that they require more medical treatment in the additional later years of their lives. In total this could perhaps result in an adverse effect that puts more strain on the health system. The less social costs of a healthier youth could therefore be offset by the higher medication costs of a prolonged life. Again this benefit is doubtful, both its magnitude and occurrence, and perhaps should be considered as a secondary effect. Alternatively, one could argue that tertiary education enables individuals at advanced age to remain on their job and to be still productive, as compared to physical labor. This could be of importance in the light of an aging society, a growing issue for Europe, which implies changes on the individual, organizational and the societal level (Maresova et al., 2015).

### 5.4 Additional benefits

Some benefits mentioned in the analyzed studies are not directly linked to the research and teaching activities of a university but rather to the institution as a whole. One of them is the claimed positive impact on the national identity, promoting an image of innovativeness and cultural ability (Janger et al., 2017). Also Florio et al. (2016) point out a cultural non-use benefit for individuals, who do not directly profit from the research output but value the creation of knowledge per se. Unfortunately, neither of the studies mentions precise numbers on that particular matter, implying the difficulty to measure this intangible benefit.

With much more confidence, Janger et al. (2017) interpret their data in regard of the overall value contributed by universities to the Austrian economy. According to their estimates, in 2015 Austria’s universities created an added value of €2.77 billion through staff and operating expenses. Furthermore, the consumption of students and staff (especially in the vicinity of the university), as well as investments of suppliers are also considered as legitimate benefits, which add another €2.7 billion to the added value (in 2015). Also Valero and Reenen (2016) hypothesize that this demand channel is another way for universities to contribute to the national GDP. In their regression model, however, they find small and insignificant evidence for the positive effect of students’ and staff consumption (of local goods and services) on growth. Thus they dismiss the demand channel, concluding that it is not what drives the relationship between universities and GDP. From investigating the channels which are of significance (human capital, innovation) Valero and Reenen (2016) find that a doubling of universities, on average, leads to 4-5
% higher GDP per capita. However, from the view of cost-benefit analysis the effects reported by Janger et al. (2017) are just multipliers and not real, direct benefits of the governmental project. The authors focused on the added value created by universities’ staff and operating expenses and labeled those expenses and their multiplier effects as benefits of universities. They refrained from considering the counterfactual scenario, the case without universities, which would reveal whether some benefits can be ascribed directly to the existence of the governmental project (i.e., the universities). In the counterfactual scenario, employees at universities would be working elsewhere, given the full-employment assumption. Their consumption, as well as that from students, of local goods and services would most likely happen nevertheless (especially expenses for housing and nutrition).

Thus the resulting tax revenues are not directly linked to the existence of the university. The staff and operating expenses are to be added to the cost side, diminishing the net present value of universities, rather than being interpreted as positive effects. This leads to biased and exaggerated results in favor of universities, and does not allow for insights on the pure net effects. Also Damon and Glewwe (2011) admonish that many economic impact studies focus on multiplier effects of the initial spending. They argue that in fact, these consumption expenditures are clearly not additional economic activity but merely a redistribution thereof. And that this misinterpretation might (again) stem from not considering the counterfactual scenario (Damon and Glewwe, 2011).

5.5 Concluding remarks on the literature

In all the analyzed studies, there are legitimate benefits and the authors managed to provide reasonable estimates for them. Most of the benefits seem to arise out of the teaching activities of universities. But this could be because of the lacking methodology and data to evaluate academic research, not to mention the accompanied difficulties of that task. The few studies which examine the benefits of research institutions (see Florio et al. (2016, 2016a), Del Bo (2016)) try to highlight the effects of research only, yet also struggle with the proper evaluation. Especially non-use benefits and benefits of product/process–unrelated research output poses a real challenge in this regard. Again this supports the notion stated earlier in this thesis that the creation of knowledge per se is of intangible nature.

In other studies, the data sufficed to gain some results but the claimed benefits turned out to be multiplier effects, which are not directly linked to the governmental project at hand, rather than true benefits in accordance with cost-benefit analysis. Because of those multiplier effects, which sum up to quite considerable amounts of money in the case of Austria (see Janger et al., 2016), the overall monetary impact of universities probably appears far larger than it really is. Under cost-benefit analysis, the results would be much more cautious since only direct effects, which do not occur in the counterfactual scenario, would be considered. By disguising costs as benefits, the examined economic impact studies apparently try to shed a remarkably positive light onto universities and their gain for society. However, by doing so, the results become biased and do not allow for a reasonable comparison of costs and benefits — further impeding the decision on which governmental projects to finance.
In summary, the studies’ results and the cost-benefit framework agree on the benefits of universities as shown in Figure 5.1. Following the discussion above, the benefits are tentatively divided in those arising from academic research, from academic teaching and from additional activities or the existence of the university; as well as in the level of their occurrence (private, governmental or as external effects).

The results of the discussed studies align with the proposed notion of this thesis that the benefits of research output are very difficult to evaluate. Especially for disciplines with little practical application (see Figure 4.1), the value of research output is of an intangible nature. As mentioned earlier, the demand effects of universities are not considered true benefits as in cost-benefit analysis. Though it might be tempting to include such multiplier effects, this exaggeration of benefits distorts the results in favor for universities. Also Florio et al. (2016) suggest to take a cautious stance when conducting a cost-benefit analysis. They further advise to exclude overly uncertain benefits instead of including some vague estimates for them, and to treat the results as lower-bounds for the benefits of the project under scrutiny.
6 Conclusion

Generally, benefits of universities arise from academic research or academic teaching. They occur on the private level as own benefits for households and firms (especially in the case of academic teaching), on the governmental level (e.g. taxes) and for the society as a whole as external effects (e.g. firms profiting from basic research, promotion of democracy). Eventually, households and firms are the beneficiaries of academic activities. The analysis of universities under a cost-benefit framework, as well as the literature review, show that the benefits of academic teaching are much easier to evaluate than those of research. For the major monetary benefits of academic teaching, such as higher life-time income of graduates and the resulting increased taxes, there exists enough data for quantification. Other claimed benefits do not have sufficient empirical evidence yet to be assigned to tertiary education without doubt (e.g. positive health effect, higher political commitment). At some points, the proposed benefits of the analyzed studies did not align with those of cost-benefit analysis (e.g. additional tax revenues from students’ consumption).

As for academic research, the quantification of the benefits depends heavily on the applicability of the research output. Therefore, a unique cost-benefit framework cannot be applied to all academic disciplines. The guiding idea was to examine the benefits of research in more detail and beyond the standard distinction in research and teaching effects (as well as basic or applied research). A distinction has to be made between disciplines which are closely related to products and production processes, to markets and the (legal) framework of economic activities and those which create knowledge per se. Based on this distinction, a tentative ranking has been done in Figure 4.1, sorting various academic disciplines by the probability that the research output can be applied to products/production processes. As mentioned before, the quantification of the benefits becomes more difficult as the link to a practical application decreases (moving from groups A-B to group E in Figure 4.1). Overall, the benefits of academic research are much more difficult to evaluate than the benefits of academic teaching.

Looking for alternative tools, one might suggest the peer review: scientists in the same field rate a project and if it should be financed or if an article should be published. There are various types of peer review (single-blind, double-blind, triple-blind, open) and it is used within a discipline to ensure a certain quality of research and of the submitted publications (Elsevier, 2018). Scientists therefore are put under pressure to meet the required quality standards of the reviewers and publishers. So the goal of peer reviews is to secure quality standards within an academic discipline. Therefore, the comparison of disciplines or their rentability for governmental funders is not being considered. Peer review has clearly other objectives than cost-benefit analysis and hence, cannot be an alternative tool to evaluate the benefits of universities.
Concluding from the results of this thesis, it seems that a true cost-benefit analysis cannot be applied in the case of university financing. There are just too many intangible benefits, which lack a proper measurement tool. Additionally, the recent literature focuses primarily on the benefits of academic teaching and sometimes exaggerates the effects in order to shed a positive light on universities. Unfortunately, only little attention is being given to the benefits of academic research, probably because of the difficult evaluation. As a consequence, the discussion about the funding of universities is necessarily reduced to a purely political decision, where interest groups, lobbying and ideological and personal opinions play a role. Decision makers cannot rely on a sound numerical base to ensure an efficient use of resources. The funding of universities hence is influenced by the PR-management of each university and its capability to explain and promote the academic activities – not necessarily with regards to an economic numerical foundation.
Bibliography


